

Effect of a real-time tele-transmission system of 12-lead electrocardiogram on the first-aid for athletes with ST-elevation myocardial infarction

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Abstract: To study the effect of a real-time tele-transmission system of 12-lead electrocardiogram on door-to-balloon time in athletes with ST-elevation myocardial infarction. A total of 60 athletes with chest pain diagnosed as ST-elevation myocardial infarction (STEMI) from our hospital were randomly divided into group A (n=35) and group B (n=25), the patients in group A transmitted the real-time tele-transmission system of 12-lead electrocardiogram to the chest pain center before arriving in hospital, however, the patients in group B not. The median door-to-balloon time was significant shorter in-group A than group B (38min vs 94 min, $p<0.01$) and the ratio of door-to-balloon time below 90 min was remarkable higher in-group A (94.2% vs 60%, $p<0.01$). The rate of catheter laboratory occupied was 5.7% in-group A and 40% in group B respectively ($p=0.001$). There was no statistically difference in mortality between the two groups (5.7% vs 4%, $p>0.05$). The median length of stay was significant reduced in-group A (5 days vs 7 days, $p<0.01$). Real-time tele-transmission system of 12 lead electrocardiogram is beneficial to the pre-hospital diagnosis of STEMI.

Keywords: Real-time tele-transmission, 12-lead electrocardiogram; door-to-balloon time; ST-elevation myocardial infarction

INTRODUCTION

As a leading cause of morbidity and mortality, cardiovascular diseases accounts for about 13 million death every year in the world according to recent statistics. The main cause of death is sudden acute events (acute coronary syndrome, malignant arrhythmia), of which more than 70% occurred outside the hospital without immediately resuscitation, especially for the people during physical training (Kashem, 2006). Therefore, early recognition and timely treatment are essential to reduce cardiovascular mortality of athletes. The establishment of coronary care unit has significantly reduced the mortality in hospitalized patients. However, more sudden cardiac deaths occur before the athletes arriving hospital but not in hospital. Hence, more attention should be paid to pre-hospital identify and care for acute myocardial ischemia and arrhythmia events (Drew *et al.*, 2006) In order to get a better outcome, pre-hospital transmitted electrocardiogram of the high-risk patients to hospital was attempted in many countries, in which a lot of methods, including a telephone transmission electrocardiogram system, the Global System for Mobile Communications, GPRS system and other remote electrocardiogram monitoring system, have been developed. However, there systems do not come into daily clinical practice because of some limitations (Scalvini *et al.*, 2005). This study is aimed to investigate effect of a new developed real-time tele-transmission

system of 12- lead electrocardiogram on Door-to-Balloon time in patients with STEMI in sports field.

MATERIALS AND METHODS

Materials

A total of 60 STEMI patients from various sports fields were included from Jan 2013 to Jun 2015 in the affiliated hospital of our university, including 35 males and 25 females. All of the subjects were diagnosed as STEMI and divided into group A (n=35) and group B (n=25) according to whether the pre-hospital electrocardiogram was transmitted to chest pain center before the patient arrived in hospital or not.

Inclusion criteria: i) The patients should have persistent chest pain more than 30 minutes, ii) Routine electrocardiogram or real-time tele-transmitted 12 lead electrocardiogram showed ST segment elevation on more than two adjacent leads, iii) The patient was diagnosed as STEMI and was suitable for primary PCI. Exclusion criteria: i) The patients who need life support system such as mechanical ventilator, intra aortic balloon counter pulsation or cardiopulmonary resuscitation machine, ii) The patients who had coexistent other factors leading to ST segment deviation such as myocardial hypertrophy, suspicious pericarditis, digitalis user, iii) The troponin was still negative in 6 ~ 12 hours after symptom onset, iv) Myocardial infarction occurred in hospital, v) Remarkable artifacts on electrocardiogram that may affect the

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interpretation, VI) The patients who refused to undergo primary PCI, vii) Refuse to sign the informed consent for this study.

Methods

The flowcharts for patients with STEMI

There were two clinical flowcharts for patients with STEMI, as following:

i) The patients in group A: The pre-hospital 12-lead electrocardiogram was transmitted to chest pain center from ambulance or local hospital and the diagnosis of STEMI was confirmed by a cardiologist before the patient arrived in hospital, the patient bypassed emergency department and coronary care unit and was directly sent to catheter laboratory to undergo the primary PCI. All of the preparations including the process of informed consent, loading dose aspirin and clopidogrel, activating catheter laboratory were undertaken on ambulance.

ii) The patients of group B: The STEMI patient directly arrived in emergency department without transmitted pre-hospital 12-lead electrocardiogram, the process of diagnosis and treatment should be guided by the following pathway. The routine electrocardiogram was acquired and read by physician of emergency department within 1 min. If STEMI was suspicious, a cardiologist was called to confirm the diagnosis and evaluate whether the patient was suitable for primary PCI or not. Then the loading doses of aspirin and clopidogrel were given and an informed consent was acquired. Then the consulting cardiologist activated catheter laboratory. After registration for hospitalization, the patient was sent to catheter laboratory for primary PCI. The catheter laboratory is available for 24 hours a day, 7 days a week including holidays. The clinical characteristics of the two groups are shown in table 1.

Major studied parameters

i) Door-to-catheter laboratory time, defined as the period from the patient arriving at the door of hospital to the time arriving at the catheter laboratory, ii) Door-to-balloon time, defined as the period from the patient arriving at the door of hospital to the time of balloon dilation or aspiration catheter pump back. The above time flow was recorded by time automatic collector which was described about, iii) The ratio of door-to-balloon time below 90min, iv) The rate of catheter laboratory occupied, defined as the catheter laboratory was occupied by the prior patient and the STEMI patient had to wait for more than 10 minutes, v) Hospital mortality defined as the rate of deaths during hospitalization, vi) The average length of hospitalization.

STATISTICAL ANALYSIS

Data were analyzed by SPSS 19.0 statistical software and described as number or percentage. Student's t-test was

used to compare the means in two groups. The time intervals were significantly skewed distribution and were represented as median and quartile. The Mann-Whitney U test (non-Parametric method) was employed to analyze these skewed distribution data. A p value <0.05 was considered statistically significant. The corresponding results are listed in table 2.

DISCUSSION

The reason analysis of the real-time tele-transmission system of 12-lead electrocardiogram reducing door-to-balloon time in athletes with STEMI

It is vital for STEMI patients to get myocardial reperfusion therapy as early as possible to save myocardium and decrease mortality, while the guidelines in many countries strongly suggest the door-to-needle time should be limited to 30 minutes, and door-to-balloon time limited to 90 minutes. Almost no hospital in our country could reach this requirements, thus only 35% patients with STEMI can get the door-to-balloon time in the guideline requirement (Sejersten *et al.*, 2008). The real-time tele-transmission system of 12 lead electrocardiogram is beneficial for the pre-hospital diagnosis of STEMI, which helps to shorten door-to-balloon time and the rate of catheter laboratory occupied as well as the length of stay, increases the rate of door-to-balloon below 90 min (Katalinic *et al.*, 2008). However, it has no significant effect on the hospital mortality of STEMI patients in this small sample study.

The reperfusion delay includes in-hospital delay and pre-hospital delay for STEMI patients, though the pre-hospital delay only account for about 25% of total delay, and the pre-hospital delay might be controlled by the medical aspects of subjective and objective factors to a great extent, so reducing the pre-hospital delay can be an important factor to the total treatment delay (Verbeek *et al.*, 2012). The factors influencing reperfusion time relates to patients, doctors and hospital for treatment process and other aspects, pre-hospital electrocardiogram is a factor, which is not to be ignored. Improving the emergency speed and efficiency for STEMI patients thus is important, for in this case the cardiovascular physicians can achieve the ECG information quickly and they can make diagnosis and decision as early as possible (Otsuka *et al.*, 2009). The construction of the domestic and foreign chest pain center's experience can also save reperfusion therapy time, improve success rate and reduce misdiagnosis rate (Kossaify *et al.*, 2012). It can also be seen in our study, that the patients received the real-time tele-transmission system of 12-lead electrocardiogram pre-hospital had been told about the risk of STEMI and the benefit of early reperfusion therapy by the first aid providers, when arriving at the hospital, after the cardiovascular physicians analyzing the disease condition and treatment strategy to the patients and their families.

Table 1: Clinical characteristics of the two groups

Characteristics	ECG transmitted pre-hospital (n=35)	ECG not transmitted pre-hospital	p-value
Gender (male)	20(57)	15(60)	0.519
Age (years)	31±6	32±7	0.427
Smoking	19(54)	14(56)	0.621
Hypertension	17(49)	12(48)	0.538
Hyperlipidemia	10(28)	9(36)	0.216
Diabetes mellitus	4(11)	6(24)	0.198
Stroke	1(2)	2(8)	0.368
Heart failure	2(6)	3(12)	0.285
Myocardial infarction	3(9)	2(8)	0.581
Coronary artery lesions			0.607
Three vessels lesion	4(11)	2(8)	
Two vessels lesion	20(57)	13(52)	
Single vessel lesion	11(31)	10(40)	
Target vessel			0.824
Anterior descending branch	22(35)	16(38)	
Circumflex	23(37)	18(43)	
Right coronary artery	18(29)	8(19)	

Table 2: Reperfusion time and prognosis comparisons of the two groups

Characteristics	ECG transmitted pre-hospital	ECG not transmitted pre-hospital	p-value
Median door-to- catheter laboratory time (min)	20	50	0.001
Median door-to-balloon time (min)	38	94	0.001
Ratio of door-to-balloon time below 90min (%)	94.2	60	0.001
Rate of catheter laboratory occupied (%)	5.7	40	0.001
Mortality in-hospital (%)	5.7	4.2	0.237
Median length of stay in -hospital (day)	5	7	0.023

They may be more comfortable to accept it and reduce the signature hesitance time. The door-to-catheter laboratory time is an another main reason of reducing door-to-balloon time, which is affected by the time that open the catheter room, apply the implementation of bypass emergency and CCU after arriving at hospital (Halimi *et al.*, 2010). The significance of the real-time tele-transmission system of 12-lead electrocardiogram on the establishment of regional cooperation for STEMI network. Due to the slow development of the pre-hospital emergency and bad cohesion between the pre-hospital and in-hospital treatment, the overall treatment level of acute myocardial infarction changes little over the past 20 years (Marinskis *et al.*, 2012). The 2013 American ACC/AHA guide about STEMI has suggested that the first medical contact to balloon time (FMC-to-B) should be further reduced to 90 minutes or less. However, the latest data from Chinese acute myocardial infarction standard treatment project has shown that at present the time of STEMI patients in our country from entering hospital gate to balloon time is appropriately 112 minutes and falling far behind of international standards. On the other hand, the distribution of medical resources is

extremely un-even; the technical level of basic medical and health institutions equipment is not high, so the STEMI treatment is not standardized. However, the majority of patients with acute myocardial infarction would firstly go into the basic level hospital, which is an important cause of low level of overall STEMI treatment. So the combination between the advantage resource in big hospital and first aid emergency treatment in grass-roots hospital is necessary in order to form a unified and efficient regional collaborative Treatment network, which can significantly improve the overall level of first aid (Crossley *et al.*, 2009).

CONCLUSION

In this paper, the effect of a real-time tele-transmission system of 12-lead electrocardiogram on door-to-balloon time in athletes is investigated. We choose 60 athletes with chest pain diagnosed as ST-elevation myocardial infarction (STEMI) as the sample and divide them into two groups, which are distinguished by whether use the real-time tele-transmission system of 12-lead electrocardiogram.

The result shows that the median door-to-balloon time was significant shorter and the ratio of door-to-balloon time below 90min was remarkable higher for patients who have used the real-time tele-transmission system of 12-lead electrocardiogram. The real-time tele-transmission system of 12-lead electrocardiogram thus is important to cure patients.

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