

Effect of Time from Response to Leaving the Scene on Survival Rate of Multiple Injuries Road Traffic Accident Patients Receiving Cardiopulmonary Resuscitation by Advance Life Support Team in Thailand

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ABSTRACT

Background

Mortality of out of hospital cardiac arrest (OHCA) due to multiple injuries during road traffic accident (RTA) raising day by day. However, there is no study on how pre-hospital time affect the survival rate of patients in Thailand.

Objective

To determine the effect of time from response to leaving the scene on survival rate of out of hospital cardiac arrest due to multiple injuries among road traffic accident patients receiving cardiopulmonary resuscitation (CPR) by the advance life support (ALS) team in Thailand.

Method

A cross-sectional study was conducted by using the data from the National Institute for Emergency Medicine of Thailand. A multivariable generalized estimation equation was used to determine the effect of time from response to leaving the scene on the survival rate of patients.

Result

Among 1,119 out of hospital cardiac arrest multiple injuries road traffic accident patients receiving cardiopulmonary resuscitation by the advance life support team, 1,043 patients were survived during transportation to the hospitals. In addition, our multivariable analysis observed that the time from response to leaving the scene of ≤ 15 minutes is associated with increasing the patient survival (Adj. OR=2.31 95%CI: 1.44 to 3.72, p value 0.001). Furthermore, other covariates such as received intravenous administration (Adj.OR=2.24; 95%CI: 1.09 to 4.61, p value 0.028) and the accidents took place in other regions when compared with the Central (Adj. OR=1.96, 95%CI: 1.13 to 3.03, p value 0.015) were also significantly associated with the survival.

Conclusion

The shorter the time from response to leaving the scene "scoop and run", the higher survival rate of the out of hospital cardiac arrest with multiple injuries among road traffic accident patients when incorporated with the effect of intravenous administration and regional factors.

KEY WORDS

Advance life support, Cardiopulmonary resuscitation, Out of hospital cardiac arrest, Road traffic accident, Scoop and run, Survival rate

INTRODUCTION

Globally, about 1.35 million deaths were due to RTAs and 90% of these mortalities were occurred in low and middle income countries.¹⁻⁶ Thailand road traffic accident fatality rate during 2010 to 2015 (21.6 to 22.3 death per 100,000 population) was accounted the world second highest position.⁷ The severity of injuries was an important determinant of RTI i.e. survival rate.⁸ The most severe multiple RTIs is cardiac arrest which needs CPR before transferring to hospital. Survival of OHCA depends on the integrity of the pre-hospital trauma chain of survival. First, early first aid to prevent immediate deterioration. In the case of OHCA multiple injuries in RTA patients, early CPR is an essential emergency lifesaving procedure. Optimal and high quality and promptly CPR can double or triple the survival rates.⁹ Early ALS team could help securing vital functions and pivotal in decreasing mortality as a result of OHCA.¹⁰ The proper management including, early defibrillation, and post resuscitation care such as advanced airway procedures, intravenous administration, and medication could efficiently improve their survival.

The time intervals during pre-hospital care was the response time starting from EMS notification of dispatch center to arrival at the scene of accident. Similarly, on scene time covers the time from arrival at the scene to the time that the ALS leaves the scene to a hospital. The interval time from response to leaving the scene is related to the concept of “scoop and run” practice of the EMS team for the injured patients.¹¹⁻¹³ Transport time is a duration between leaving the scene and reaching a hospital. The total time interval starts from notification of dispatch center to arrival at a hospital which is largely determined by distance from the scene to hospital. A pre-hospital time within 60 minutes after trauma is considered as “golden hour”, and an acceptable goal of trauma care. A study indicated an association between a short total pre-hospital time and patient survival.¹⁴ On scene time is related to injury severity and EMS procedure performed.¹⁵ Many urban EMS systems conform to specific standards on the acceptable duration of on scene care.

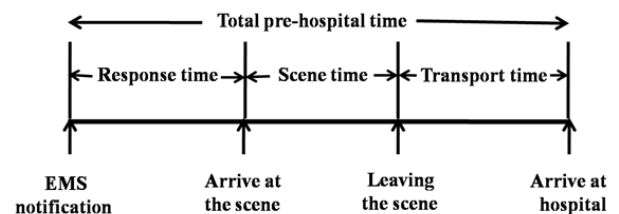
Out of hospital emergency medical service in Thailand divided into 3 teams: 1) an ALS team consisted of at least a nurse and/or an emergency medical technician (EMT) or paramedic (EMT-P) and/or an emergency medical technician. 2) The intermediate (EMT-I) or an emergency medical technician basic (EMT-B) consisted of an emergency medical technician (EMT) or paramedic (EMT-P) and/or an emergency medical technician. This team is for basic life support (BLS) 3) A first responder (FR), is mostly volunteers from local administration organizations, not for profit organizations.^{16,17} ALS emergency medical service team mandates is effectively perform CPR and critical medical care to these OHCA with multiple injuries RTA patients. The ALS effectiveness is importance to improve these patient survivals. However, it is a life threatening events. Thus,

times use in pre-hospital care are importance. In addition there is no research on how pre-hospital time affect the survival of these RTA patients in Thailand. Therefore, the aim of this study was to determine the effect of time from response to leaving the scene on survival rate of OHCA due to multiple injuries in RTA patients who received CPR by ALS emergency medical service team in Thailand when control others covariates.

METHODS

This study was conducted by using secondary data of the National Institute for Emergency Medicine (NIEM), Thailand. The study population was OHCA cases due to multiple injuries in RTA patients who received CPR by ALS team during 2011 to 2013. OHCA with multiple injuries among RTA patients who received CPR by ALS emergency medical service team during 2011 to 2013 were included. Although, the RTA patients who died without getting CPR by the ALS team were excluded. Therefore, the total of 1,119 patients who met the inclusion criteria were selected.

The factors of interest was the time ALS emergency medical service team used to provide CPR and emergency service to OHCA with multiple injuries in RTA patients. It includes: 1) response time: a time from EMS notification to arrival at the scene, 2) on scene time: a time interval between arrived at the scene and living for a hospital, 3) transport time: a time between leaving the scene and arrived at the hospital, and 4) total pre-hospital time covers all the three time period of response, at scene and transport times (Fig. 1).¹⁷⁻²¹



Descriptive statistics were used to describe the patients, EMS service and survival status of the OHCA multiple injuries in RTA patients receiving CPR by ALS team. The frequency of number and percentage were reported for categorical data including: age group, gender, receiving the intravenous fluid administration and regions. Mean, standard deviation, median, minimum and maximum were computed and reported for continuous data of the pre-hospital times for EMS services including: response time, scene time, transport time, response to leaving the scene and pre-hospital times, in minutes. Inferential statistics were used for bivariate and multivariable analyses to identify factors associated with depressive symptoms. In the bivariate and multivariable analysis each period of pre-hospital times were classified into 2 groups including: The factors that had p value < 0.25, or indicated by literatures to have an association with patient’s survival were processed into the multivariable analysis.²² Generalized estimating

equation (GEE) was applied to identify association between time from response to leaving the scene and the survival of OHCA multiple injuries RTA patients when controlling the clustering effects of the province with the goodness of fit model and choosing the best correlation structure based on Akaike's information criterion (AIC), presenting Adjusted OR with 95% confidence interval (CI) as magnitude of effect. P value less than 0.05 was considered statistically significant. All analyses were performed using Stata version 10.0 (StataCorp, College Station, TX).

RESULTS

Of the total 1,119 OHCA cases with multiple injuries in RTA patients receiving CPR by ALS team, most of them were males (79.07%) with the mean age of 36.5 ± 17.3 years old, the highest proportion were observed among the patients aged 20-39 years (41.14%) (table 1) Nearly all patients received intravenous fluid (92.58%). The average total pre-hospital time was 22.52 minutes (SD=12.44) with the median=20 (min: max; 1: 85), the average response time was 9.2 minutes (SD \pm 6.0) with the median of 8 minutes (min: max; 2: 55), 72.92% had scene time \leq 7 minutes. Majority of the patients had time from response to leaving the scene within 15 minutes (61.39%) with the average of 15.87 minutes (SD = 10.77) and a median = 13 minutes (min: max; 1: 130).

Table 2 illustrate that the association between independent variables and survival rate of on OHCA with multiple injuries in RTA patients receiving CPR by ALS team: A bivariate analysis. Among 1,119 OHCA among multiple injuries RTA patients receiving CPR by ALS team, 1,043 patients were survived during transportation to the hospitals. The simple logistic regression analysis was performed to identify the association between individual independent factors and the patient's survival rate which indicated that the factors associated with the patient survival rate were, time from response to leaving the scene \leq 15 minutes, transport time \leq 8 minutes, male gender (OR=1.20; 95%CI: 0.65 to 2.22, p value 0.559), received intravenous fluid administration, accident took place in other 3 regions aside from the Central. Therefore, the abovementioned factors were proceeded to the multivariable analysis. However, age groups which had p value 0.888 was also proceeded to the multivariable analysis based on the literature review.

The multivariable analysis using GEE indicated that the OHCA multiple injuries RTA patients receiving CPR by ALS team who had time from response to leaving the scene \leq 15 minutes had 2.31 fold higher odds of being survived (95%CI: 1.44 to 3.72, p value 0.001 (table 3). In addition, other covariates such as received intravenous fluid (Adj.OR = 2.24; 95%CI: 1.09 to 4.61, p value 0.028 was significant with the patient's survival rate. Similarly, the OHCA among multiple injuries RTA patients receiving CPR by ALS team in the North, South, and Northeast regions were 1.96 higher

Table 1. Demographic characteristics of OHCA multiple injuries RTA patients receiving CPR by ALS team (n = 1,119)

Variable	Number	Percentage
Patients demographics		
Age (year)		
< 40	651	60.06
\geq 40	130	39.94
Mean = 36.52 , SD = 17.34 ; Median = 34 (Min : Max ; 1: 90)		
Gender		
Male	835	79.07
Female	221	20.93
Intravenous fluid administration		
Did not receive	83	7.42
Received	1036	92.58
Regions		
Northeast	407	36.37
Central	373	33.33
North	239	21.36
South	100	8.94
Pre-hospital time (minute)		
Response to leaving the scene time (minute)		
\leq 15	687	61.39
> 15	432	38.61
Mean = 15.87 , SD = 10.77 ; Median = 13 (Min : Max ; 1: 130)		
Response time (minute)		
\leq 8	632	56.48
> 8	487	43.52
Mean = 9.18 , SD = 6.03 ; Median = 8 (Min : Max ; 1: 55)		
Scene time (minute)		
\leq 7	816	72.92
> 7	303	27.08
Mean = 6.46 , SD = 6.87 ; Median = 5 (Min : Max ; 1: 62)		
Transport time (minute)		
\leq 8	341	30.64
> 8	772	69.36
Mean = 13.43 , SD = 9.12 ; Median = 11 (Min : Max ; 1: 76)		
Total time (minute)		
\leq 25	767	68.54
> 25	352	31.46
Mean = 22.52 , SD = 12.44 ; Median = 20 (Min : Max ; 1: 85)		

odds of survived (95%CI: 1.13 to 3.03, p value 0.015) than those in the central region. Although, the transport time, age, and gender were not significantly associated with the patient's survival rate.

DISCUSSION

RTA has been a great threats on public health and national development of low and middle income countries since decades. It accounts one of the leading cause of injuries,

Table 2. Relationship between risk factors and survival rate during transportation of OHCA multiple injuries RTA patients receiving CPR by ALS team using bivariate analysis GEE (n=1,119)

Variable	Total number	% of Survival	Crude OR	Adjusted OR	P value
Response to leaving the scene time (minute)					0.001
> 15	432	89.81	1		
≤ 15	687	95.34	2.27	1.42-3.62	
Transport time (minute)					0.079
> 8	772	92.49	1		
≤ 8	341	95.31	1.65	0.94-2.89	
Age (year)					0.888
< 20	205	93.17	1		
20 - 39	446	93.05	1.01	0.53-1.92	
40 - 59	303	92.41	0.91	0.46-1.79	
≥ 60	130	94.62	1.28	0.52-3.19	
Gender					0.559
Male	835	93.05	1		
Female	221	94.12	1.20	0.65-2.22	
Intravenous fluid administration					0.064
Did not receive	83	87.95	1		
Received	1036	93.63	1.95	0.96-3.95	
Regions					0.008
Central	429	90.44	1		
North, South, Northeast	690	94.93	1.96	1.20-3.20	

Table 3. Effect of response to leaving the scene time on survival rate of OHCA multiple injuries RTA patients receiving CPR by ALS team: A multivariable analysis using GEE (n=1,119)

Variable	Total number	% of Survival	Crude OR	Adjusted OR	95%CI	P value
Response to leaving the scene time (minute)						0.001
> 15	432	89.81	1	1		
≤ 15	687	95.34	2.27	2.31	1.44-3.72	
Intravenous fluid administration						0.028
Did not receive	83	87.95	1	1		
Received	1036	93.63	1.95	2.24	1.09-4.61	
Regions						0.015
Central	429	90.44	1	1		
North, South, North-east	690	94.93	1.96	1.96	1.13-3.03	

*adjusted for transport time age and gender

disabilities, and mortality. Effectiveness of EMS is one of an important component to help mitigating the health burden of RTA injuries. Survival of OHCA among multiple injuries RTA patients requires high quality CPR, airway management,

interventions fluid administration which were carried out by competent providers, and team communication during transportation and received good trauma care at the hospital. Therefore, it is of great significance to improve the level of pre-hospital trauma emergency treatment to ensure people's life safety. The patient survival rate relied on various factors such as competency of ALS team, severity of injuries, distance from the dispatch center, and the scene situations.²³ This study focused on the survival rate of OHCA multiple injuries RTA patients who received CPR by ALS team. Since the OHCA multiple injuries RTA patients are critical patients who need promptly and effectively resuscitation and care by high standard EMS team to save their life before arriving at the hospital. The advance life support (ALS) team is a well-trained EMS team with high competency to provide EMS to these critical patients. The question is how they should the ALS perform the EMS, whether they should "scoop and ran" or stay and play. Previous studies indicated that pre-hospital time is associated with survival of OHCA in RTA patients. Scoop and run is one of the pre-hospital approach trauma care come from an examination of specific field interventions at the scene in which the patient is transported as fast as possible to the hospital. Our result of the multiple GEEs model time from response to leaving the scene ≤ 15 minutes increase the survival rate of OHCA multiple injuries RTA patients receiving CPR by ALS team by 2.31 times. Sampalis et al. indicated that longer time spent outside the hospital in minute increased patient mortality risk by 5%.²⁴ A study in Thailand found that increased response time, at scene time and transport times per minute resulted in reducing the odd of survival before arriving at a hospital of the OHCA patients.²⁵ Similarly, a study in Ghana reported a response time less than 17 minutes could increase the survival rate of the trauma patients, despite the recommendation of an eight minute response time.²⁶ A research on helicopter EMS service indicated that there was a strong positive linear correlation between helicopter EMS on-scene time and mortality, $R = 0.962$, $p = 0.038$, and a positive trend between helicopter EMS dispatch time and mortality.²⁷ Our study result also indicated that the patients that received IV fluid transfusion had 2.24 times higher odds of survival rate. It was similar with the results from another study in Thailand reported that IV fluid administration was associated with increasing survival of resuscitated OHCA patients before arriving at a hospital. IV fluid helps increasing intravascular volume, cardiac output and improve organ perfusion during cardiopulmonary resuscitation as well as increased blood pressure after patient return of spontaneous circulation (ROSC). Isotonic crystalloids help expanding the volume of intravascular fluid hence increasing blood pressure in delivering red blood cells and oxygen to body tissues.²⁵ The hypertonic saline infusion during resuscitation of OHCA help the patient gaining spontaneous circulation before admission a hospital.^{25,28} Concerning the regional influence of which other regions had better survival than

the Central region. It might be that the Northeast, North and South consisted of big provinces with lower population density as well as vehicle per population ratio. Therefore, the coordination of EMS team, pre-hospital care and time might be better for survival. The Central, on the other hand, consisted of more small provinces with complicate intercity and district road networks. Most of the Central provinces were located along the intercity highways and super highways with at least four lanes surface road. The vehicles were very fast which had impact on accident severities as well as could have poorer coordination if the accident took place at the borders of districts or provinces.

The strength of our study is that it is a nationally representative study with big sample size and had a high power of test of 94.98%, therefore the results could be generalize to the population. This study did not include Bangkok metropolitan since it covers by many EMS organizations.

CONCLUSION

The shorter the time from response to leaving the scene “scoop and run” increased the survival rate of the OHCA multiple injuries RTA patients who received CPR by ALS

EMS Team in Thailand with the cooperated effect of IV fluid administration and regional factors. A short response to leaving on scene time meant that the patient was quickly resuscitated, stabilized and loaded into an ambulance within a few minutes to transport to a hospital as soon as possible. Therefore, high competency ALS team is essential for efficient management of airway, breathing, circulation, and immobilization, with proper ambulance and equipment as well as at scene situational assessment and management.

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