Turkish Journal of Emergency Medicine 15 (2015) 113–115

HOSTED BY

Contents lists available at ScienceDirect

Turkish Journal of Emergency Medicine

journal homepage: http://www.elsevier.com/locate/TJEM

Low oxygen saturation is associated with pre-hospital mortality among non-traumatic patients using emergency medical services: A national database of Thailand

Yuwares Sittichanbuncha [a], Sorrawit Savatmongkorngul [a], Puchong Jawroongrit [a], Kittisak Sawanyawisuth [b, c, *]

[a] Department of Emergency Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
[b] Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand
[c] The Research Center in Back, Neck, Other Joint Pain and Human Performance (BNOJPH), Khon Kaen University, Khon Kaen, Thailand

ARTICLE INFO

Article history:
Received 16 September 2014
Received in revised form
22 December 2014
Accepted 21 January 2015
Available online 17 November 2015

Keywords:
Prehospital
Mortality
Emergency medical services
Emergency medical care
Risk factors

ABSTRACT

Background: Pre-hospital emergency medical services are an important network for Emergency Medicine. It has been shown to reduce morbidity and mortality of patients by medical procedures. The Thai government established pre-hospital emergency medical services in 2008 to improve emergency medical care. Since then, there are limited data at the national level on mortality rates with pre-hospital care and the risk factors associated with mortality in non-traumatic patients.
Aims: To study the pre-hospital mortality rate and factors associated with mortality in non-traumatic patients using the emergency medical service in Thailand.
Methods: This study retrieved medical data from the National Institute for Emergency Medicine, NIEMS. The inclusion criteria were adult patients above the age of 15 who received medical services by the emergency medical services in Thailand (except Bangkok) from April 1st, 2011 to March 31st, 2012. Patients were excluded if there was no treatment during pre-hospital period, if they were trauma patients, or if their medical data was incomplete. Patients were categorized as either in the survival or non-survival group. Factors associated with mortality were examined by multivariate logistic regression analysis.
Results: During the study period, there were 127,602 non-traumatic patients who used pre-hospital emergency medical services in Thailand. Of those, 98,587 patients met the study criteria. For the statistical analyses, there were 66,760 patients who had complete clinical investigations. The mortality rate in this group was 1.89%. Only oxygen saturation was associated with mortality by multivariate logistic regression analysis. The adjusted OR was 0.922 (95% CI 0.8550.994).
Conclusion: Low oxygen saturation is significantly associated with pre-hospital mortality in a national database of non-traumatic patients using emergency medical services in Thailand. During pre-hospital care, oxygen level should be monitored and promptly treated. Pulse oximetry devices should be available in all pre-hospital services.

1. Introduction

Pre-hospital emergency medical services are an important network for Emergency Medicine. There are several medical procedures or treatments that may be performed during pre-hospital periods. Studies have shown that morbidity and mortality rates may be lowered by emergency medical care in the pre-hospital setting in both traumatic and non-traumatic conditions.[1–4] Increase survival rate is more common in traumatic patients who received pre-hospital care.[4] For non-traumatic conditions, patients with some particular diseases have been shown to benefit from pre-hospital treatment, such as chronic obstructive pulmonary disease (COPD) or myocardial infarction.[3,4]

The Thai government established the pre-hospital emergency medical service in 2008 to improve emergency medical care. The patients can reach the pre-hospital medical care by calling a

* Corresponding author. Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.
E-mail address: kittisak@kku.ac.th (K. Sawanyawisuth).
Peer review under responsibility of The Emergency Medicine Association of Turkey.

http://dx.doi.org/10.1016/j.tjem.2015.11.003

toll-free number (1669) which will connect them to the nearest hospital. An equipped ambulance is then assigned to the scene by the call center. Transportation and treatment may be performed during the pre-hospital period. All data are reportedto the National Institute for Emergency Medicine (NIEMS) by using an online system. During our study period, there were 12,691 registered ambulance units all over Thailand. These ambulance units were comprised of 2183 (17.2%) units at the advanced life support level, 42 units (0.3%) at the intermediate life support level, 1837 (14.5%) units at the basic life support level, and 8629 (68.0%) first responder units. The first two levels are operated by hospitals and well-equipped, while the two latter levels are operated by communities or foundations. This study aimed to evaluate the mortality rate and to identify risk factors associated with mortality in non-traumatic patients who used pre-hospital medical service at the national level. Knowing these factors may help to reduce the pre-hospital mortality rate.

2. Methods

This study retrospectively retrieved medical data from the NIEMS (http://www.niems.go.th/th/DefaultTH.aspx). The inclusion criteria were adult patients (defined as age >15 years) who had received medical services by the emergency medical service from in Thailand (except Bangkok) from April 1st, 2011 to March 31st, 2012. We excluded patients who required only transportation, traumatic patients, or patients with incomplete medical data.

The NIEMS has an electronic database called Testing of Information Technology for Emergency Medical System (ITEMS; http://items2.niems.go.th/t_items_front/OverView.aspx). ITEMS receives data from all hospitals with available emergency medical service in Thailand. Input data of all patients who activated the emergency medical system by the 1669 system were recorded to the system. Data collected include patient characteristics, presenting symptoms, initial vital signs, initial Glasgow Coma Scale (GCS), initial oxygenation, initial glucose from a finger stick (DTX), treatments, and outcomes.

Patients were categorized in either the survival or non-survival group. Mortality was defined as pre-hospital mortality either at the site or during pre-hospital period. Clinical features between both groups were compared by descriptive statistics. The Student t-test and Chi-square tests were applied to compare the differences in numbers and proportions between the two groups.

Univariate logistic regression analyses were used to calculate the crude odds ratio for each variable for mortality. Variables with $p < 0.20$ in univariate analysis or clinically significant variables were included in subsequent multivariate logistic regression analyses. Analytical results were presented in terms of crude odds ratio (OR), adjusted OR, and 95% confidence interval (CI). The goodness-of-fit of the final model was evaluated using Hosmer–Lemeshow statistics. All data analyses were performed on a personal computer using Stata software version 10.1 (StataCorp, College Station, TX, USA). The study protocol was approved by the Institutional Review Board of Mahidol University.

3. Results

During the study period, there were 127,602 non-traumatic patients using the pre-hospital emergency medical services in Thailand. Of those, 29,005 patients were excluded as shown in Flow Chart 1 due to: no outcome data (24,415 patients); age less than 15 years (4095 patients); and required only transportation (495 patients). In total, 98,597 patients were included in the study.

Clinical features of all patients were shown in Table 1. The mean age was 57.55 years (SD 19.84) and male gender accounted for 51.00%. Out of 98,597 patients, there were 1859 patients (1.89%) who died during pre-hospital medical care. The two most common presenting symptoms of patients who died were loss of consciousness (59.8%) and cardiac arrest (7.8%). Clinical features between the survival and non-survival groups were not statistically different for heart rate and respiratory rate (Table 2).

By multivariate logistic regression analysis, only oxygen saturation was associated with mortality mortality (Table 3). The adjusted OR (95% CI) was 0.922 (0.855, 0.994). The Hosmer–Lemeshow value of the final model was 2.62 (p value 0.956).

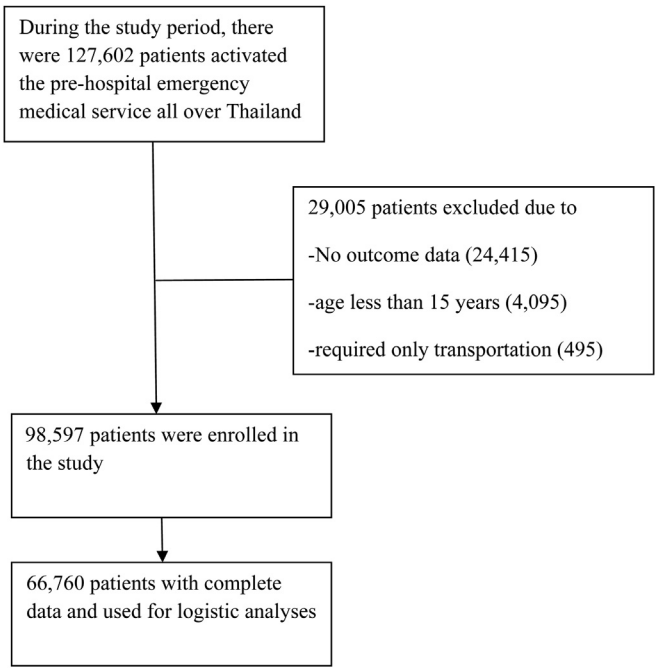

Chart 1. Flow chart 1 showed eligible patients in the study.

4. Discussion

The nationwide pre-hospital mortality rate for non-traumatic patients was 1.89%. Initial oxygen saturation was the only significant factor associated with pre-hospital mortality according to our analysis of the Thai national EMS database. Previous studies showed that low systolic blood pressure was a predictor for mortality[5–8] in various settings including heart failure, blunt trauma,

Table 1
Clinical features of non-traumatic patients using pre-hospital emergency medical services in Thailand.

Clinical features	N = 98,597
Mean age, years	57.55 (19.84)
Male gender, N (%)	47,488 (51.00)
Transport time to hospital, minutes	10.24 (7.94)
Body temperature (°C)	37.07 (0.96)
Systolic blood pressure, mmHg	129.99 (32.20)
Diastolic blood pressure, mmHg	77.73 (18.12)
Mean arterial pressure, mmHg	95.19 (21.59)
Heart rate, bpm	93.66 (21.02)
Respiratory rate, tpm	23.33 (5.80)
Glasgow coma score	13.14 (3.66)
Oxygen saturation, %	94.56 (6.68)
DTX, mg/dL	136.19 (74.22)

Note. Total number may not equal to 98,597 due to missing data; DTX: glucose finger-stick; data presented as mean (SD) unless indicated otherwise.

Table 2
Clinical features of non-traumatic patients using pre-hospital emergency medical services in Thailand, categorized by outcome.

Clinical features	Survival N = 96,738	Non-survival N = 1859	p value
Mean age, years	57.49 (19.88)	61.50 (17.33)	<0.001
Male gender	46,413 (50.72)	1075 (67.70)	<0.001
Transport time to hospital, minutes	10.27 (7.96)	8.94 (6.84)	<0.001
Body temperature (°C)	37.07 (0.95)	36.08 (0.92)	<0.001
Systolic blood pressure, mmHg	130.00 (32.19)	97.33 (53.30)	<0.001
Diastolic blood pressure, mmHg	77.73 (18.12)	63.74 (30.75)	<0.001
Mean arterial pressure, mmHg	95.19 (21.58)	77.65 (36.42)	<0.001
Heart rate, bpm	93.66 (21.01)	92.18 (21.87)	0.302
Respiratory rate, tpm	23.34 (5.80)	22.87 (6.37)	0.235
Glasgow coma score	13.20 (3.59)	5.70 (4.69)	<0.001
Oxygen saturation, %	94.59 (6.64)	88.92 (12.12)	<0.001
DTX, mg/dL	135.97 (73.88)	156.15 (97.99)	<0.001

Note. Total number may not equal to 98,597 due to missing data; DTX: glucose finger-stick; data presented as mean (SD) unless indicated otherwise.

and patients with chest pain or coronary artery disease. This study used mean arterial pressure instead of systolic or diastolic blood pressure in the multivariate logistic analysis to avoid the issue of multicollinearity. However, the mean arterial pressure was not significantly associated with mortality.

Pulse oximetry has been shown to be a reliable and beneficial tool during pre-hospital care.[9] Initial oxygen saturation was negatively associated with pre-hospital mortality. In other words, initial low oxygen saturation increased risk of mortality during pre-hospital periods. Every 1% increase in oxygen saturation decreased the chance of mortality by 8% (Table 3). Oxygen supplementation may therefore be a valuable treatment during transportation.

A previous report showed that oxygen supplement during pre-hospital care improved survival and symptoms of COPD patients.[3] A systematic review also indicated that patients with respiratory diseases or myocardial infarction had better survival rate.[4] These conditions may have better outcomes with oxygen treatment during the pre-hospital care. This study adds information that patients with low oxygen saturation during pre-hospital period are at risk for mortality. Oxygen saturation should be used as an additional warning sign other than standard vital signs such as blood pressure and heart rate. These patients need urgent treatment and transportation. Oxygen supplement in appropriate cases is recommended. However, oxygen supplement should be given with caution in patients with COPD.

The strength of this study is that the sample size is large and representative of the entire country of Thailand, although data from Bangkok were not included. The data retrieved from the NIEMS is computerized, which should minimize problems with transferring of data. However, the possibility for human error exists during the data input process by the emergency medical service staff. Several factors have been reported as associated with mortality, such as transfer time. Another study showed that physicians participating in emergency medical services had better outcomes.[4,10] These factors are limited by the data retrieved from the national database

Table 3
Univariate and multivariate logistic analysis associated with mortality in non-traumatic patients using pre-hospital emergency medical services in Thailand.

Factors	Univariate odds ratio (95% confidence interval)	Multivariate odds ratio (95% confidence interval)
Mean arterial pressure, mmHg	0.960 (0.938, 0.981)	0.980 (0.938, 1.024)
Heart rate, bpm	0.997 (0.990, 1.003)	0.959 (0.915, 1.004)
Respiratory rate, tpm	0.985 (0.960, 1.010)	1.038 (0.909, 1.186)
Oxygen saturation, %	0.939 (0.929, 0.948)	0.922 (0.855, 0.994)

Note. The model was adjusted for age, sex, oxygen saturation, dextrostrix (glucose finger-stick), and transport time.

system. In our multivariate analysis, transport time was not a significant factor. One explanation is that the emergency medical service (EMS) system in Thailand is distributed throughout Thailand, and the EMS service is determined by the nearest site identified by phone call. The diagnosis of each patient cannot be retrieved from the database system because the EMS system in Thailand rarely has physicians accompanying ambulances, and EMS technicians reported the data.

5. Conclusions

Initial low oxygen saturation is significantly associated with pre-hospital mortality in non-traumatic patients using emergency medical services in a national database of Thailand. During pre-hospital care, oxygen saturation should be monitored with prompt treatment. Pulse oximetry devices should be available in all pre-hospital services.

References

1. Wang HE, Balasubramani GK, Cook LJ, Lave JR, Yealy DM. Out-of-hospital endotracheal intubation experience and patient outcomes. *Ann Emerg Med*. 2010;55:527–537.
2. Ryynänen OP, Iirola T, Reitala J, Pälve H, Malmivaara A. Is advanced life support better than basic life support in prehospital care? A systematic review. *Scand J Trauma Resusc Emerg Med*. 2010;18:62–76.
3. Austin MA, Wills KE, Blizzard L, Walters EH, Wood-Baker R. Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomised controlled trial. *BMJ*. 2010:341–349.
4. Botker MT, Bakke SA, Christensen EF. A systematic review of controlled studies: do physicians increase survival with prehospital treatment? *Scand J Trauma Resusc Emerg Med*. 2009;17:12–20.
5. Takahashi M, Kohsaka S, Miyata H, et al, Tokyo CCU Network Council. Association between prehospital time interval and short-term outcome in acute heart failure patients. *J Card Fail*. 2011;17:742–747.
6. Marisa A, Regina M. Clinical and prehospital survival indicators in blunt trauma: a multivariate analysis. *Rev Esc Enferm USP*. 2010;44:350–357.
7. Lalezarzadeh F, Wisniewski P, Huynh K, et al. Evaluation of prehospital and emergency department systolic blood pressure as a predictor of in-hospital mortality. *Am Surg*. 2009;75:1009–1014.
8. Herlitz J, Hansson E, Ringvall E, et al. Predicting a life-threatening disease and mortality among ambulance-transported patients with chest pain or other symptoms raising suspicion of an acute coronary syndrome. *Am J Emerg Med*. 2002;20:588–594.
9. McGuire TJ, Pointer JE. Evaluation of a pulse oximeter in the prehospital setting. *Ann Emerg Med*. 1988;17:1058–1062.
10. Vukmir RB. Prehospital cardiac arrest and the adverse effect of male gender, but not age, on outcome. *J Womens Health (Larchmt)*. 2003;12:667–673.