# The Role of Emergency Medical Services in Stroke: A Hospital-based Study in Kaohsiung, Taiwan

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**Abstract-**

*Purpose:* Emergency medical services (EMS) play an important role in acute stroke therapy. The goal of this study was to investigate the roles and determinants of EMS in stroke in Southern Taiwan, Kaohsiung.

*Methods:* We enrolled stroke patients who arrived at emergent department (ED) of the study hospital within 48 hours after the onset of symptoms. Patients were categorized into arriving by EMS or not EMS. Potential determinants of EMS use for stroke were examined by multivariable analyses and the role of EMS in stroke was discussed.

*Results:* Among 197 stroke patients enrolled, only 44 (22%) patients arrived by EMS at ED. Multivariable logistic regression analysis revealed that the determinants of EMS use were stroke severity measured by NIHSS and non-family member who decided to seek help. Using EMS or not was not associated with the earlier presentation after stroke within 2 hours after attack.

*Conclusion:* EMS use was far from sufficient. The transportation time was not the major component of pre-hospital delay. Both EMS and other vehicles provided prompt delivery. The public should rush to ED either by EMS or other transportation modes when stroke occurred unless use of EMS is proved to provide better outcome in stroke patient in the future study.

**Key Words:** Emergency medical services, Stroke, Transportation

## INTRODUCTION

Stroke is a major cause of disability and death in Taiwan. In 2000, there were more than 100,000 cerebrovascular disease inpatients[1]. Although recombinant tissue plasminogen activator (rtPA) has been approved in Taiwan for acute ischemic stroke, a large portion of patients cannot be treated within 3 hours after the onset of symptoms due to prehospital delay[2]. Prehospital delay had been shown to be one of the most critical barriers in acute stroke therapy[3]. To search for methods decreasing prehospital delay is imminent and the understanding the role of emergency medical services (EMS) is crucial.

Ambulance utilization in Taiwan is developing and growing. In 1990, the government divided Taiwan into 17 regional EMS authorities, and directed the fire department to train fire fighters to serve as emergency medical technicians (EMTs) as a means of developing an integrated EMS system. The fire department was formerly a subsidiary of the police department. In 1995, the fire administration split from the police department, and was established as a separate entity. As Taiwan develops, the effects on the patterns of ambulance-use patterns in regions with different geographic, educational, and socioeconomic characteristics become more apparent. Ambulances in Taiwan are dispatched without a prioritization policy, and EMTs respond to all calls. Ambulance use is free of charge in Taiwan. EMTs are the first responders in the EMS and serve as firefighters as well. There are two EMTs in each ambulance, and they stay at the assigned fire station between calls. Ambulances are sent out by a central dispatch center only. Run reports are completed by the ambulance crew and checked by an emergency department nurse. The reasons for each call and any intervention performed at the scene, and vital signs, are also recorded in each run report.

Previous studies had shown that the activation of EMS was associated with early presentation at ED and treatment in stroke patients[4-8]. The role of EMS had been discussed in other emergent medical situations in Taiwan but studies describing the role of EMS in acute stroke were scanty in this country and also in other Asian countries. The purpose of this study was to investigate the role of EMS in stroke in Southern Taiwan, Kaohsiung based on a medical center's data.

## METHODS

This study was performed before rtPA was approved and was conducted in an area with three million habitants in southern Taiwan. The study hospital is a medical center provides tertiary care and also serves as the primary care facility.

The inclusion criteria were stroke patients who sought help at the ED within 48 hours after the onset of symptoms. Exclusion criteria were the lack of specific time of symptom-onset. All patients were examined by at least one neurologist. A preset structured interview of the patients, families, relatives or witnesses was made within 24 hours after admission.

From September 1998 to March 1999, 197 consecutive acute stroke patients were enrolled. Information including demographic data, living alone or not, time of onset of symptoms, nature of initial response, time to first contact healthcare system or call for help, the recognition of symptoms, the knowledge and attitude about stroke were collected. Data regarding the identity of the person who first noticed symptoms, who called for medical help and the location of the patient at the onset of symptoms were recorded. If the symptoms occurred during sleep, the onset time was the last time known to be symptom free.

First time recorded in ED was defined as arrival time. Prehospital delay was defined as the time from the onset to the arrival at the ED of the study hospital. Decision delay was defined as the time of symptoms identified to the decision to seek medical help and thus was a component of the prehospital delay. National Institutes of Health Stroke Scale (NIHSS) was assessed within 24 hours after the admission by qualified neurologist.

For statistical tests, a level of less than 0.05 was considered statistically significant. Categorical variables with the use of EMS for stroke were evaluated by Chi-square tests whereas continuous variables were evaluated by student t-test. Because of the skewed distribution of the times, the Mann-Whitney test was used for comparisons of time differences. Associations of the factors with the use of EMS for stroke were obtained by using multivariate analysis. Only age, sex and significant (p<0.05) factors obtained from univariate analysis were included in the multivariate analysis. The factors examined were age, sex, non-resident in Kaohsiung city/county, other who identified the symptoms, non-family member decided to seek help, thought of no need of emergent medical care, consciousness disturbance, pre-hospital delay < 5 hours and NIHSS. SPSS 10.0 software (SPSS, Chicago, IL) was used for statistical analysis.

## RESULTS

Of the 197 patients included in the analysis, the mean age was $63.3 \pm 12$ years and 41% (81) were female. Twenty-two percent of the patients were transported by EMS. The median hospital arrival time after the onset of symptoms was 5.3 hours (interquartile range, 1.9 to 13.9). The median transportation time was 30 minutes (interquartile range, 15 to 45). Median time of decision delay was 4 hours (interquartile range, 0.8 to 13.4). Seventy-eight percents of the patients lived within the catchment area (Kaohsiung city/county). First-ever stroke was identified in 78.2%; intracranial hemorrhage was identified in 15.2% of the patients. The median NIHSS score was 7 (interquartile range, 4 to 12). While 20.8% of the patients were identified by others, 72.6% of the patients recognized neurological symptoms by themselves. For those whose neurological symptoms were

**Table 1.** *Characteristics of the patients and stroke*

| | EMS (n = 44) n (%) | Non-EMS (n = 153) n (%) | p-value |
|---|---|---|---|
| Age | $63.8 \pm 12$ | $63 \pm 12$ | 0.73 |
| Gender (male) | 30 (68%) | 86 (56%) | 0.16 |
| Residency (other than Kaohsiung city/county) | 15 (34.1%) | 29 (19%) | 0.04* |
| Other who identified the symptoms | 16 (36.4%) | 25 (16.3%) | < 0.01* |
| Non-family member who decided to seek help | 24 (54.5%) | 54 (35.3%) | 0.02* |
| Educational level of person decided to seek help (above junior high) | 17 (38.6%) | 69 (45.1%) | 0.49 |
| Living alone | 2 ( 4.5%) | 6 ( 3.9%) | 1.00 |
| Thought of no need of emergent medical care | 9 (20.5%) | 25 (16.3%) | 0.50 |
| Co-morbidities | 30 (68.2%) | 110 (71.9%) | 0.70 |
| | | | |
| Initial neurological symptoms | | | |
| Focal neurological deficits | 26 (59.1%) | 117 (76.5%) | |
| Consciousness disturbance | 11 (25%) | 18 (11.8%) | 0.05 |
| | | | |
| Stroke severity (NIHSS) | | | |
| Median (25th-75th percentiles) | 12 (8-22) | 6 (4-9) | < 0.01* |
| | | | |
| Stroke subtype | | | |
| First-ever stroke | 37 (84.1%) | 117 (76.5%) | 0.31 |
| Intracranial hemorrhage | 11 (25%) | 19 (12.4%) | 0.06 |
| | | | |
| Decision delay, hours | | | |
| Median (25th-75th percentiles) | 2.5 (0.6-8) | 5 (0.8-14.5) | 0.17 |
| < 1.5 hours | 17 (39%) | 50 (33%) | 0.47 |
| | | | |
| Pre-hospital delay, hours | | | |
| Median (25th-75th percentiles) | 3.3 (2.0-10.9) | 6.3 (1.9-14.5) | 0.13 |
| < 2 hours | 11 (25%) | 41 (26.8%) | 1.00 |
| < 5 hours | 28 (63.6%) | 66 (43.1%) | 0.03* |
| | | | |
| Transportation time, hours | | | |
| Median (25th-75th percentiles) | 0.5 (0.3-0.8) | 0.5 (0.5-0.7) | 0.42 |
| < 0.5 hour | 36 (81.8%) | 120 (78.4%) | 0.30 |
| < 1 hour | 30 (68.2%) | 90 (58.8%) | 0.68 |

*: p < 0.05

**Table 2.** *Multivariable logistic regression analysis of determinants of EMS use*

| Determinants | Odds ratio (95% C.I.) | p-value |
|---|---|---|
| Age | 1.0 (0.9-1.0) | 0.97 |
| Gender(female) | 0.6 (0.3-1.4) | 0.21 |
| Non-resident in Kaohsiung city/county | 2.2 (0.9-5.4) | 0.06 |
| Other who identified the symptoms | 1.5 (0.4-6.3) | 0.60 |
| Non-family member decided to seek help | 2.4 (1.1-5.4) | 0.03 |
| Thought of no need of emergent medical care | 1.5 (0.5-5.2) | 0.49 |
| Consciousness disturbance | 0.7 (0.1-3.4) | 0.61 |
| Pre-hospital delay < 5 hours | 1.8 (0.8-3.9) | 0.2 |
| NIHSS | 1.1 (1.0-1.2) | < 0.0001 |

identified by others, 14.7% were found to have consciousness disturbance. There were 17.3% of the patients having the idea of no need for emergent medical attention. The most frequent stroke risk factors were hypertension (53.8%), diabetes mellitus (31%), smoking (16.8%), cardiac diseases (14.2%) and family history of stroke (10.7%); in contrast, alcohol consumption (8.6%) and dyslipidemia (6.1%) were less common risk factors.

The characteristics of the patients and stroke are shown in Table 1. Multivariable logistic regression analysis revealed that the stroke severity measured by NIHSS [odds ratio (O.R.) 1.1, 95% confident interval (C.I.) 1.0 to 1.2] and non-family member decided to seek help (O.R. 2.4, 95% C.I. 1.1-5.4) were the determinants of EMS use for stroke (Table 2). Using EMS or not was not associated with earlier presentation within 2 hours after stroke (p=1.0).

## DISCUSSION

To our knowledge, this is the first study to investigate the role of EMS in acute stroke in Taiwan. The use of EMS by stroke patients did not ameliorate prehospital delay in this area. Patients with more severe stroke, those whose decision of seeking medical help was made by non-family members were more likely to use EMS. Previous experience of stroke, stroke subtype, co-morbidities, age, sex, place of residency and educational level of the person who decided to seek help did not increase the use of EMS.

In our study, there was no difference in prehospital delay between EMS use and non-EMS use. More than

60% of the patients waiting for more than 1.5 hours to make decision to seek medical help could explain this result. Since the current NINDS guideline of rtPA treatment should be given within 3 hours after the onset of stroke[9], using EMS or not did not increase the chance of receiving acute stroke therapy in this area. The majority of our patients arrived by other vehicles instead of ambulance and could arrive at the study hospital as quick as using EMS. The public was encouraged to use more EMS to rush to hospital when at the onset of stroke because studies in other countries had shown that EMS transport and direct activation of the emergency telephone system by patients or proxies without prior medical contact could admit the patients earlier. Since no similar studies had been done in Taiwan, we suggested that before EMS use is proved to provide better outcome in stroke patients, the public should rush to ED either by ambulance or other transportation modes in this area. As compared with western countries, the use of EMS was far from sufficient in Taiwan stroke patients, only 22% of our patients arriving by EMS. Less well-organized EMS, lack of the awareness of the emergent situation of stroke and inability of calling EMS by the public could be the reasons for this situation. In contrast, 38-70% of stroke patients arrived at the hospital via EMS transport in western countries[4-5,10-12]. Barsan et al.[10] found that 47% of American stroke patients used the emergency telephone system as their first medical contact, and this number increased to 65% for those patients presenting within the first 1.5 hours.

Our study showed that travel time was not the major component of delay which mirrored other western stud-

ies[5]. So, the access to a hospital was not a hindrance in this area whether using EMS or other vehicles. About 80% of the patients could arrive at ED of the study hospital within 30 minutes. As we mentioned before, the major component of delay was waiting too long to call or make decision to seek for medical help.

Although two significant determinants of EMS had been identified in this study, further discussion seemed meaningless because using EMS or not was not associated with earlier ED presentation in this area as shown in other studies[13-16]. These determinants will become important if patients arrived by EMS show better clinical stroke outcome in the future studies. Prehospital delay did exist in this area and remained the major problem in acute stroke treatment, but the transportation modes or the travel time were not the major component of the delay.

In conclusion, the public should use either EMS or other transportation modes to rush to ED at the onset of stroke in order to have better chance to be eligible for acute stroke therapy. Further studies need to be done to see the impact of EMS use on clinical stroke outcome compared with those arrived at ED by other transportation modes since EMS not only provides transportation, but also basic life support especially for those with severe stroke, functional limitations, medically unstable or less capable of being driven by other vehicles.

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