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Effects of Pre-Arrival Hospital Notification by Emergency Medicine Service System on Acute Stroke Patients: A New Experience in Kaohsiung City

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Abstract

Background: Acute ischemic stroke is a time-sensitive disease. Previous study has identified the most onset-to-thrombolytic delay occurs in the prehospital phase. Pre-arrival hospital notification by EMS (emergency medicine system) could elimination some of the prehospital delay and has been recommended to increase the chance of administering thrombolytic therapy. Pre-arrival hospital notification by EMS is a new experience in Kaohsiung metropolitan, Taiwan. This study aimed to explore the effect of EMS pre-notification.

Methods: Stroke patients confirmed by hospital and suspected stroke patient pre-arrival notified by emergency medicine technicians (EMT) in the period of April to December 2013 were enrolled. Group comparisons were made between patients with and those without pre-notification using Student's t-test, Chi-square test, and Fisher's exact test. Logistic regression was performed to determine the association between variables with the early completion of brain CT.

Result: The study hospital received 1082 stroke patients in the study period, 237 (21.9%) of them were sent by EMS. 46 patients were sent to ED with pre-arrival hospital notification by EMT. The group with pre-arrival hospital notification had shorter door-to-CT and door-to-doctor times than the no pre-arrival notification group. However, there was no difference in the time lapse of door-to-drug. Factors of pre-arrival notification and hemorrhagic stroke were associated with early completion of brain CT in 10 minutes, with an OR of 6.3 (95% CI, 3.14-12.74) and 1.9 (95% CI, 1.00-3.59), respectively.

Conclusion: Pre-arrival hospital notification by EMS can shorten the elapsed time of door-to-CT and door-to-doctor, but not of door-to-drug. Patients' hesitation may contribute the long lapse of CT-to-drug delivery. Simultaneous efforts to promote awareness of stroke in the community are recommended to shorten the time lapse of door-to-drug in synergy.

Keywords: Stroke; Advance notification; Emergency medicine system; Computer tomography; Emergency department

Introduction

In 2011, stroke was one of the top five leading causes of death worldwide [1]. The situation was similar in Taiwan, where stroke was the third leading cause of death in 2011 [2]. The average annual incidence rate for people aged >36 years was about 330 per 100,000 [3]. Acute ischemic stroke is a time sensitive disease and patient outcomes are dependent on the elapsed time between symptom onset and the reperfusion by administration thrombolytic therapy [4]. So, like in Western countries, the emergency departments (ED) in Taiwan have exerted efforts to reduce the elapsed time between arrival at the ED and provision of thrombolytic therapy with intravenous (IV) tissue-plasminogen activator (tPA). To maximize the benefit of reperfusion to the ischemic area and minimize the risk of intra-cerebral hemorrhage, brain computed tomography (CT) should be immediately acquired and interpreted. This will guide the neurologic assessment by the stroke team to evaluate if the use of IV tPA is indicated. If indicated, the drug should be delivered as soon as possible.

To initiate the cascade of responses, ED needs the collaboration of different departments in the hospital. The ED physicians may re-allocate the priority of resource utilization when they detect stroke patients. If pre-arrival hospital notification is available, the time cost of waiting for triage, physician assessment and detection, communication for the request of brain CT, and call for neurologist consultation can be minimized. Some researches reveal the advantages of pre-arrival hospital notification by the emergency medicine system (EMS) [5-8] and a set-up of pre-arrival hospital notification by EMS is advised [5,9,10]. However, pre-arrival hospital notification by EMS is not well practiced in Taiwan.

The present study aimed to determine the effects of EMS pre-arrival hospital notification. This was a new experience for the EMS of Kaohsiung metropolitan. The accuracy of tools used for the field assessment of stroke was also determined.

Methods

Settings

This research was conducted under the approval of institutional review board of Kaohsiung Chang Gung Memorial Hospital and was funded by the Chang Gung Medical Research Program. The one-year program launched stroke re-training activities to emergency medicine technicians (EMT) in the first 3 months, and conducted a protocol of on-field stroke detection and pre-arrival hospital notification. The study patients were enrolled in the other 9 months. The re-training activities assisted EMTs in reviewing the pathophysiology, symptoms and current treatment concepts of stroke, and acquainted them with which hospitals have the capability to provide qualified management to stroke patients and had been accredited by health authority of city government [11,12]. The education activities equipped EMTs the ability to perform field assessment of stroke, and implanted the protocol of sent patients to stroke-prepared hospital with pre-arrival notification. The EMTs notified the receiving hospital staff prior to arrival at the ER if they found an abnormality in the field assessment of stroke. The Cincinnati Pre-hospital Stroke Survey (CPSS) combined with onset-time evaluation (fewer than 3 hours) were used as the tool for assessing stroke [13].

Taiwan has implemented National Health Insurance (NHI) since 1995; the population coverage has reached 99.5% by 2013. Also the major parts of prehospital emergency medicine care, such as ambulation transportation and care delivered on ambulance are served by fire bureau of county/city governments. The emergency medicine service provided by fire bureau of county/city governments is free of charge. Kaohsiung city is located in southern Taiwan as well as the second largest city of this island. The city has 2.77 million residents (population density, 941 people per square kilometer), 10.4% of them are over 65 years old, and there are 50 EMS stations served this city.

Study population

The study hospital, Kaohsiung Chang Gung Memorial Hospital, is a medical center situated in the southern Taiwan. This hospital has a capacity of 2724 beds.

Stroke patients who visited the research hospital between April and December 2013 were screened. The cases of stoke were confirmed if the patient was certified as having the short-term Catastrophic Illness Card. With this certification, patients obtained more finical support from the National Health Insurance.

Only patients sent to the ED by ambulance were included. Patients transferred from other facilities were excluded. The suspect acute stroke patients sent to the ED by EMS with pre-arrival hospital notification were also enrolled. Because of three-month re-training activity to implant the pre-notification protocol, only patients from April to December 2013 were enrolled.

The EMTs were taught to perform CPSS when they suspected patients having stroke. If patients complained of any "weakness", or found as a fall accident without open wound/limbs deformity/ depressed consciousness, CPSS was mandatory.

The purpose of the training activity was to implant the protocol of pre-arrival hospital notification for acute stroke patient. After the training program, the EMTs were expected capable of identifying the right patient (field detection of acute stroke), sending to right place (the nearest stroke-prepared hospital), and giving pre-arrival notification to the hospital that would receive the patient.

Data collection

All of the patients' data were collected via hospital charts and emergency medicine records made by EMT. The demographics (age, sex), vital signs (systolic and diastolic blood pressure, pulse rate, respiratory rate, Glasgow coma scale), triage result, chief complaints, result of brain CT scan, NIHSS (National Institutes of Health Stroke Scale) score in the ED, discharge diagnosis, and status of hospital discharge were collected. The timelines of arrival at the ED, ED physician assessment, neurologist assessment, brain CT scan completion, and IV tPA delivery were also obtained. The time of brain CT scans completions were according to the time stamps on the digital films, as stored in the picture archive and storage system (PACS). The timelines of ED physicians' assessment were obtained from time points at which the first medical orders were prescribed on the charts, while the time of neurologist's assessments were obtained from the time points at which the consultation sheets were completed.

Statistical analysis

Continuous variables of baseline characteristics were reported as mean ± standard deviation. Between-group (with vs. without pre-notification) comparisons were made by Student's t-test. Categorical variables were reported as numbers and percentages, and between-group comparisons were made using Chi-square test and Fisher's exact test. The time length variables of ED arrival to the completion of CT scan, ED arrival to the ED physician's assessment, ED arrival to the neurologist, and ED arrival to IV tPA administration were all reported as median and inter-quartile range (IQR), since these were not normally distributed. Between-groups comparisons were performed by Wilcoxon's rank sum test.

Logistic regression analysis was done on the observed outcome of completion of CT scan less than 10 minutes. Although the 2010 American Heart Association guidelines of management of patients with suspected stroke recommended order emergency CT scan within 10 min [14], we set brain CT completion in 10 minutes as an observed outcome because ED physicians could evaluate the imaging results immediately with the help of the digital image and communications in medicine (DICOM) and PACS system.

Statistical significance was set at a two-tailed $p<0.05$. All analyses of variables were performed using the SAS 9.3.

Results

The hospital ED received 123,215 patients in the period of January to December 2013, including 69,328 adult non-trauma patients. There were 1424 acute stroke patients certified as having the short-term Catastrophic Illness Card by the National Health Insurance. Between April 1, 2013 and December 31, 2013, there were 1082 consecutive stroke patients, 237 (21.9%) of them were sent to the ED by EMS (Figure 1). Among all the stroke patients, only 8 patients received thrombolytic therapy, and 46 patients were sent to the ED with pre-arrival hospital notification.

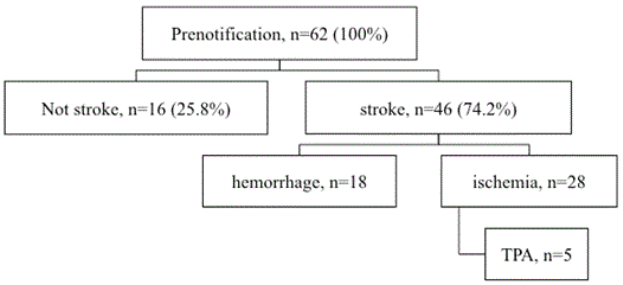

Figure 1: Brief of suspect stroke patients sent to the emergency department of study hospital by ambulance.

The Fire Bureau of Kaohsiung City Government received 126,541 calls in year of 2013. In the period of January to December 2013, the EMS made pre-notification for 62 suspected patients (Figure 2), of which 46 (74.2%) were confirmed cases. Among the stroke patients with pre-notification, 28 were ischemic stroke, including five who received IV tPA treatment.

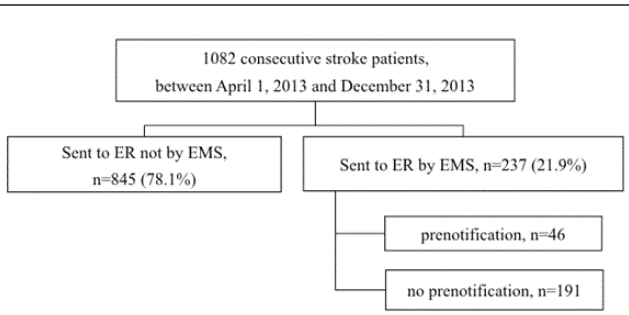

Figure 2: Brief of stroke patients received by the study hospital.

Based on the patients' baseline characteristics (Table 1), the mean age was 67.6 ± 13.2 years. Among them, 65.0% were men (n=154) and 65.8% (n=156) had ischemic stroke. The median time of door-to-ED physician's assessment was 23.9 min (11.3-47.8 min). The time of door-to-CT scan, door-to-neurologist's assessment, and door–to-IV tPA were 23.9 (11.3-47.8), 40.1 (19.0-100), and 72.1 (65.4-91.8) min, respectively. The median NIHSS score was 16 (9-38).

Comparing the pre-notification group and the no pre-notification group, the time of door-to-CT, door-to-ED physician's assessment, and door-to-neurologist's assessment were shorter in the pre-notification group. The pre-notification group also had a higher possibility of receiving thrombolytic therapy. Variables of sex, door-to-tPA, NIHSS score, and ratio of ischemic type stroke were not statistically different between the two groups.

Table 2 showed the performance of on-field assessment of stroke with the Cincinnati Prehospital Stroke Scale and onset time evaluation. The sensitivity was 19.4%, and the positive predictive value (PPV) was 74.2%. The PPV result was similar to the Western world, but the sensitivity was low. This might be due to poor adherence to protocol, further survey the knowledge and skill retention of EMTs would be needed; or the conditions (limbs weakness, fall accident) to trigger stroke survey mandatorily was only 2. Among the 16 false positive cases, the diagnoses were hypoglycemia (n=2), peripheral vertigo (n=2), hypokalemia (n=2), sepsis (n=2), syncope (n=2), C-spine myelopathy, seizure, schizophrenia, metastatic malignancy, diabetes polyneuropathy, and acute renal failure.

Under the logistic regression model, patients with pre-notification and patients with hemorrhagic stroke were associated with shorter door-to-CT time. Sex, age, and NIHSS score in the ED were not associated with shorter door-to-CT time. Multivariate logistic regression analysis revealed that hemorrhagic stroke patient had an odds ratio (OR) of 1.9 (95% CI, 1.00-3.59) and patients with pre-notification had an OR of 6.3 (95% CI, 3.14-12.74) (Table 3).

Discussion

Stroke is the third leading cause of death in Taiwan and acute ischemic stroke is a time-sensitive disease, whose outcome is dependent on the time that elapsed from symptom onset to receipt of thrombolytic therapy. In stroke guidelines, pre-arrival hospital notification has been recommended to reduce the time lapse after symptom onset. Studies in Taiwan have revealed that the pre-hospital factor plays a significant role in treatment delays [15,16]. Factors contributing to prehospital delay are fail to recognize the symptoms of stroke at onset, fail to seek help from EMS, fail to be detected by emergency medical system and to be delivered to the stroke-prepared hospital. The pre-arrival hospital notification by EMS can shorten the time lapse between stroke onset and arrival at ED, and accelerate the protocol of stroke management in ED. In Taiwan, the protocol of pre-arrival hospital notification by EMS has not been well established. The present study demonstrates that, for acute stroke patients, pre-arrival hospital notification can shorten the door-to-CT, door-to-ED physician's assessment, and door-to neurologist's assessment times. Inferentially, these should be beneficial in shortening the time lapse of door-to-drug (IV tPA). However, in the present study, this is not an advantage of pre-notification by EMS (Table 1).

Protocols of pre-arrival hospital notification by EMS have been carried out in the other metropolitans of the word. Some of the effects comparisons have been shown in Table 4 [7,8,10]. But the effects observed in Kaohsiung seem not to have all the benefits.

In this study, we note most stroke patients do not seek help from the EMS when symptoms arise (Figure 1). Only 21.9% of patients are sent to the ED by EMS even though the ambulance service is free of charge. Moreover, acute stroke patients often hesitate when they are advised to receive thrombolytic therapy if indicated. They, together with their families, may be too anxious or distracted to fully understand and appreciate the advice given by the stroke team in the ED environment, and usually does not make the decision until the last moment. These facts reveal that community people have poor disease awareness and do not recognize well the symptoms at the onset, so the rate of EMS utilization is low. Also they do not know the time-sensitive nature of acute ischemia stroke; either have little idea of the efficacy of thrombolytic therapy, so patients hesitate to receive IV tPA immediately after conditions explanation and giving suggestion by stroke team.

Since pre-notification by the EMS can shorten the time lapse of door-to-CT and door-to-doctor, efforts should be made to promote stroke awareness and explain the benefits and risk of thrombolytic therapy in the community. Without community communication in advance, the door-to-drug time would not be improved by EMS pre-arrival notification. If people have good awareness of stroke, they can

seek help via EMS in a timely manner [17,18], and become less hesitant to thrombolytic therapy. For people with vascular risks, like as diabetes mellitus, hypertension, etc., awareness education might be incorporated to the disease and care management model in the primary health care system.

There are several tools used by the EMT to assess stroke in the field [19]. The Cincinnati Pre-hospital Stroke Scale is used in this study because it is easy to learn and be memorized. Even though performance during the study period is not as good as those in other parts of the world [13,20,21], the system is still in its learning phase. Based on the cases of false positive pre-notification, checking fingertip sugar can improve performance. More learning in simulation may improve the sensitivity of pre-hospital assessment [22].

Results of multivariate logistic regression also reveal that stroke patients of the hemorrhagic type are associated with shorter door-to-CT time. This may be because the clinical manifestations of hemorrhagic stroke are more obvious compared to ischemic stroke [23,24]. As such, the triage staff can detect the patients more easily, resulting in faster response.

Limitations

There were some limitations in this study. First, this study was not able to include stroke patients who expired at the ED before they were admitted to the hospital. Because the diagnosis of stroke was confirmed by certification of the Catastrophic Illness Card, the application was not completed when the patients expired in the ED, and for patients those were not admitted to the hospital. Second, this study did not control the educational level and financial status of patients, even though these may be related to the background knowledge or awareness of stroke. Third, this research is a one single center study. Further studies involving collaborations with multiple centers and adjustments for patient background are suggested.

Conclusions

Pre-arrival hospital notification by EMS can shorten the time lapse of door-to-CT and door-to-doctor, but not door-to-drug. Simultaneous efforts to promote stroke awareness in the community are suggested to short the time lapse of door-to-drug in synergy.

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References

1. The top 10 causes of death.
2. (2011)Cause of death statistics in 2011.
3. Hu HH, Sheng WY, Chu FL, Lan CF, Chiang BN (1992) Incidence of stroke in Taiwan. Stroke 23: 1237-1241.
4. Pereira VM, Gralla J, Davalos A, Bonafé A, Castaño C, et al. (2013) Prospective, multicenter, single-arm study of mechanical thrombectomy using Solitaire Flow Restoration in acute ischemic stroke. Stroke 44: 2802-2807.
5. Lin CB, Peterson ED, Smith EE, Saver JL, Liang L, et al. (2012) Emergency medical service hospital prenotification is associated with improved evaluation and treatment of acute ischemic stroke. Circ Cardiovasc Qual Outcomes 5: 514-522.
6. McKinney JS, Mylavarapu K, Lane J, Roberts V, Ohman-Strickland P, et al. (2011) Hospital Prenotification of Stroke Patients by Emergency Medical Services Improves Stroke Time Targets. Journal of stroke and cerebrovascular diseases: the official journal of National Stroke Association.
7. Abdullah AR, Smith EE, Biddinger PD, Kalenderian D, Schwamm LH (2008) Advance hospital notification by EMS in acute stroke is associated with shorter door-to-computed tomography time and increased likelihood of administration of tissue-plasminogen activator. Prehospital emergency care: official journal of the National Association of EMS Physicians and the National Association of State EMS Directors 12: 426-431.
8. Gladstone DJ, Rodan LH, Sahlas DJ, Lee L, Murray BJ, et al. (2009) A citywide prehospital protocol increases access to stroke thrombolysis in Toronto. Stroke 40: 3841-3844.
9. (2013) STROKE TRAINING FOR EMS PROFESSIONALS.
10. Mosley I, Nicol M, Donnan G, Patrick I, Kerr F, et al. (2007) The impact of ambulance practice on acute stroke care. Stroke 38: 2765-2770.
11. Hospital emergency medical capability grading standards.
12. Wong KH, Lob SC, Lin CF, Lasser B, Mun SK (2009) Imaging components for a robotic casualty evaluation system. Conf Proc IEEE Eng Med Biol Soc 2009: 467-470.
13. Kothari RU, Pancioli A, Liu T, Brott T, Broderick J (1999) Cincinnati Prehospital Stroke Scale: reproducibility and validity. Ann Emerg Med 33: 373-378.
14. Chan Y, Gentile N, Hazinski MF, Jauch EC, Cucchiara B, et al. (2010) Part 11: Adult Stroke: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 122: S818-S828.
15. Tan TY, Chang KC, Liou CW (2002) Factors delaying hospital arrival after acute stroke in southern Taiwan. Chang Gung Med J 25: 458-463.
16. Chang KC, Tseng MC, Tan TY (2004) Prehospital delay after acute stroke in Kaohsiung, Taiwan. Stroke 35: 700-704.
17. Hachinski V (2002) Awareness: the first step to action. Stroke 33: 1173.
18. Bray JE, Mosley I, Bailey M, Barger B, Bladin C (2011) Stroke public awareness campaigns have increased ambulance dispatches for stroke in Melbourne, Australia. Stroke 42: 2154-2157.
19. Bray JE, Coughlan K, Barger B, Bladin C (2010) Paramedic diagnosis of stroke: examining long-term use of the Melbourne Ambulance Stroke Screen (MASS) in the field. Stroke 41: 1363-1366.
20. You JS, Chung SP, Chung HS, Lee HS, Park JW, et al. (2013) Predictive value of the Cincinnati Prehospital Stroke Scale for identifying thrombolytic candidates in acute ischemic stroke. Am J Emerg Med 31: 1699-1702.
21. Studnek JR, Asimos A, Dodds J, Swanson D (2013) Assessing the validity of the Cincinnati prehospital stroke scale and the medic prehospital assessment for code stroke in an urban emergency medical services agency. Prehospital emergency care: official journal of the National Association of EMS Physicians and the National Association of State EMS Directors 2013, 17: 348-353.
22. Gordon DL, Issenberg SB, Gordon MS, LaCombe D, McGaghie WC, et al. (2005) Stroke training of prehospital providers: an example of simulation-enhanced blended learning and evaluation. Med Teach 27: 114-121.
23. Andersen KK, Olsen TS, Dehlendorff C, Kammersgaard LP (2009) Hemorrhagic and ischemic strokes compared: stroke severity, mortality, and risk factors. Stroke 40: 2068-2072.
24. Ciccone MM, Aquilino A, Cortese F, Scicchitano P, Sassara M, et al. (2010) Feasibility and effectiveness of a disease and care management model in the primary health care system for patients with heart failure and diabetes (Project Leonardo). Vasc Health Risk Manag 6: 297-305.