A Comparison of Emergency Medical Services Times for Stroke and Myocardial Infarction

Kelly R. Evenson, PhD, Emily B. Schroeder, MSPH, Trent B. Legare, BA,
Jane H. Brice, MD, MPH, Wayne D. Rosamond, PhD, Dexter L. Morris, PhD, MD

Abstract

Objective. Since stroke symptoms are often vague, and acute therapies for stroke are more recently available, it has been hypothesized that stroke patients may not be treated with the same urgency as myocardial infarction (MI) patients by emergency medical services (EMS). To examine this hypothesis, EMS transport times were examined for both stroke and MI patients who used a paramedic-level, county-based EMS system for transportation to a single hospital during 1999. **Methods.** Patients were first identified by their hospital discharge diagnosis as stroke (ICD-9 430–436, n = 50) or MI (ICD-9 410, n = 55). Trip sheets with corresponding transport times were retrospectively obtained from the 911 center. A separate analysis was performed on patients identified by dispatchers with a chief complaint of stroke (n = 85) or MI (n = 372). **Results.** Comparing stroke and MI patients identified by ICD-9 codes, mean EMS transport times in minutes did not meaningfully differ with respect to dispatch to scene arrival time (8.3 vs 8.9, p = 0.61), scene time (19.5 vs 21.4, p = 0.23), and transport time (13.7 vs 16.2, p = 0.10). Mean total call times in minutes from dispatch to hospital arrival were similar between stroke and MI patients (41.5 vs 46.4, p = 0.22). Results were similar when comparing patients identified by dispatchers with a chief complaint indicative of stroke or MI. **Conclusion.** In this single county, EMS response times were not different between stroke and MI patients. Replication in other EMS settings is needed to confirm these findings. **Key words:** cerebrovascular disorders; emergency medical services; myocardial infarction; stroke; time factors.

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Address correspondence and reprint requests to: Kelly Evenson, PhD, Department of Epidemiology, School of Public Health, 137 East Franklin Street, Suite 306, Chapel Hill, NC 27514. e-mail: <kelly_evenson@unc.edu>.

The American Heart Association emphasizes the importance of treating both stroke and myocardial infarction (MI) as emergencies because of the time-dependent nature of medical therapies for both conditions.[1] Goals set by the American Heart Association include increasing the percentage of stroke patients arriving at the hospital within three hours from symptom onset to 20% and increasing the percentage of MI patients arriving at the hospital within one hour of symptom onset to 20% and within six hours of symptom onset to 90%.[1]

The chain of events from the onset of symptoms to treatment involves several steps, each contributing to overall delay time. The emergency medical services (EMS) system plays a key role in helping patients reach medical care quickly. Since stroke symptoms are often vague, and acute therapies for stroke are more recently available, stroke patients may not be considered by EMS with the same urgency as MI patients. In some circumstances, dispatchers may use a nonemergent response mode because the symptoms communicated to them may not seem urgent or may not be recognized.[2] A better understanding of how EMS responds to calls from patients with stroke and MI could lead to professional and public interventions aimed at making progress towards the American Heart Association goals. The objective of this study was to compare EMS transport times for stroke and MI patients who used a county-based EMS system during 1999.

Methods

The University of North Carolina (UNC) School of Medicine Institutional Review Board approved the protocol for this study. Patients discharged from the UNC Hospitals with a stroke or MI diagnosis during 1999 and who were transported to the hospital by Orange County, North Carolina, EMS were identified from hospital records. Eligible cases were defined using hospital discharge diagnosis codes (International Classification of Diseases version 9, or ICD-9). Discharge diagnosis codes 430–436 were used to define stroke events, and 410 for MI events. If the patient had more than one stroke discharge diagnosis code, then the lowest numeric ICD-9 code was assigned.

Orange County EMS is a nontraditional system that

TABLE 1. Chief Complaints Reported to the Paramedic (in Percentages*) among Patients Identified by Hospital Discharge Diagnosis

	Stroke (n = 47)	Myocardial Infarction (MI) (n = 54)
Cerebrovascular accident/stroke	42.6	3.7
Sick call	10.6	9.3
Breathing problems	12.8	16.7
Unconsciousness	6.4	1.9
Rule out MI/chest pain	4.3	48.2
Fall	4.3	0
Unresponsiveness	4.3	1.9
Shortness of breath	2.1	11.1
Diabetes-related complaints	2.1	1.9
Hemorrhage	0	1.9
Abdominal pain	0	1.9
Other†	10.6	1.9

*Percentages may not add up to 100% due to rounding.

†Other category includes chief complaints identified for only one patient.

sends paramedics in initial response vehicles to every call for medical assistance. The dispatcher receiving the call for assistance determines the mode of response (e.g., lights and sirens) and the number of additional resources required (e.g., first responder, transporting basic life support ambulance) based on emergency medical dispatch cards (Advanced Medical Priority Dispatch System). The estimated total population of Orange County as of July 1999 was 109,746, with 82% white race.[3] The county covers 400 square miles. From July 1999 to June 2000, the dispatch center received 152,357 calls for assistance.

Information pertaining to each trip is routinely recorded on standardized forms by both the medic evaluating the patient and the transporting personnel. The data were collected retrospectively and EMS providers were unaware of the study. During the study period there was no additional training or public campaign for emergency stroke and MI treatment, other than the standard practice in this county. The EMS trip sheets for all eligible patients identified in the search of hospital discharge codes were abstracted by research personnel. In this county, timing of events is recorded by EMS personnel on the trip sheet with times provided by the dispatcher using a computer-aided dispatch system.

Arrival time was defined as the time from EMS dispatch until EMS arrival at the scene. Scene time was defined as the time from arrival of the first EMS unit until the patient was taken from the scene. Transport time was defined as the time from when the EMS unit left the scene until it arrived at the emergency department. Total call time was defined as the time from EMS dispatch until the EMS unit reached the emergency department. Times were taken first from the medic trip sheet. If the medic trip sheet was missing either the time of departure from the scene or the time of arrival to the hospital, then the corresponding time was taken from the ambulance trip sheet. All other times were taken from the medic trip sheet only. For patients with one or more missing times, the times were extracted from the call-for-service reports.

The priority of each call, as determined by the 911 operator, was categorized as either with or without lights and sirens. In this county, use of lights and sirens to the scene indicated a high-priority, life-threatening emergency. The protocol specified that if the dispatcher suspected a stroke or MI, the paramedic was dispatched at highest priority (lights and sirens) and the ambulance at medium priority (no lights and sirens). The chief complaint was based on classification made by the 911 operator from caller information. The chief complaint was communicated to the paramedic and ambulance en route to the scene. Once reaching the scene, the paramedic decided whether an ambulance was needed and whether transport to the hospital warranted lights and sirens. Triage was defined by the paramedic as urgent (dead or imminent mortal condition or need for physician evaluation within one to four hours) and nonurgent (need for physician evaluation within 24 hours). The triage level was used to communicate with emergency department personnel.

Patients with a dispatch diagnosis of "CVA/stroke" (CVA = cerebrovascular accident) and "rule out MI/chest pain" were identified for separate analyses by obtaining all call-for-service reports for patients with a dispatch diagnosis indicative of stroke or MI. These reports reside on a computerized database for all calls into the EMS system for the county. Arrival, scene, transport, and total call times were defined identically for these patients as compared with patients identified by ICD-9 codes. All 911 calls that did not result in transport to the hospital were excluded. Other covariates of interest were not available for analysis of these patients (e.g., age, gender, race, use of lights and sirens, triage).

Statistical Analyses

We excluded patients who walked into the EMS center and patients who had both a stroke and MI diagnosis according to the ICD-9 codes. We also excluded one incident involving a disabled EMS vehicle. Means were compared with the nonparametric Wilcoxon two-sample test and categorical data were compared with the Mantel-Haenszel chi-square statistic. Multivariable linear regression models were used to examine whether having a stroke or MI ICD-9 diagnosis predicted shorter arrival time, scene time, transport time, and total call time separately. These statistical models controlled for age, gender, race, triage, and use of lights and sirens to the scene. In addition, for the models predicting transport time and total call time, use of lights and sirens to the hospital was also included. All analyses were performed using SAS Version 6.12 (SAS Institute, Inc., Cary, NC).

RESULTS

There were 50 stroke patients included with the following discharge diagnoses: ten hemorrhagic stroke (ICD-9 430–432), 38 ischemic stroke or transient cerebral ischemia (ICD-9 433–435), and two acute but ill-defined cerebrovascular disease (ICD-9 436). There were 55 acute MI diagnoses (ICD-9 410). Stroke patients were on average older than MI patients (mean 78.2 vs 72.6 years, p = 0.03), but there was no significant difference by gender (54.0% vs 54.6% female, p = 0.96) or ethnicity (77.6% vs 68.5% white, p = 0.31). For stroke and MI patients, uses of lights and sirens to the scene (83.7% vs 90.7%, p = 0.28) and to the hospital (18.4% vs 13.0%, p = 0.45) were also similar. The MI patients were more likely to be triaged as urgent (89.1%) compared with the stroke patients (73.5%, p = 0.04). Table 1 shows the dispatch chief complaints communicated to the paramedic for stroke and MI patients identified by ICD-9 codes. Among the stroke patients, 42.6% were dispatched as "CVA/stroke" and among the MI patients, 48.2% were dispatched as "rule out MI/chest pain."

Mean arrival times, scene times, transport times, and total call times were similar for the stroke and MI patients identified by ICD-9 codes (Table 2). The patterns were further examined using multivariable linear regression models, controlling for age, gender, ethnicity, triage, and the use of lights and sirens. Comparing MI patients with stroke patients, arrival times, scene times, transport times, and total call times were not significantly different. Additionally, transport times did not differ by age, gender, or ethnicity. The use of lights and sirens to the scene was associated with a shorter arrival time (–4.4 minutes, 95% CI –7.5, –1.3), scene time (–9.3 minutes, 95% CI –13.7, –4.9), and total call time (–12.7 minutes, 95% CI –21.9, –3.5) as compared with not using lights and sirens to the scene. However, the use of lights and sirens to the hospital was not significantly associated with transport time or total call time. Omitting triage and use of lights and sirens from the models did not change the result for the stroke vs MI time comparisons.

TABLE 2. Mean Prehospital Delay Times (in Minutes; Interquartile Ranges in Parentheses) by Stroke and Myocardial Infarction (MI) Hospital Discharge Diagnosis

	Stroke (n = 50)	MI (n = 55)	p-value
Arrival time	8.3 (4–11)	8.9 (5–12)	0.61
Scene time	19.5 (15–23)	21.4 (17–25)	0.23
Transport time	13.7 (8–16)	16.2 (9–23)	0.10
Total call time	41.5 (30–49)	46.4 (33–52)	0.22

TABLE 3. Mean Prehospital Delay Times (in Minutes; Interquartile Ranges in Parentheses) by "CVA/Stroke" and "Rule Out MI/Chest Pain" Dispatch Chief Complaint*

	"CVA/Stroke" (n = 85)	"Rule Out MI/ Chest Pain" (n = 372)	p-value
Arrival time	7.9 (5–11)	7.6 (5–10)	0.51
Scene time	20.3 (15–24)	19.0 (14–23)	0.19
Transport time	17.0 (10–22)	16.6 (9–24)	0.84
Total call time	44.7 (36–55)	42.8 (33–51)	0.21

*CVA = cerebrovascular accident; MI = myocardial infarction.

Time intervals for patients with a dispatch chief complaint of "CVA/stroke" (n = 85) and "rule out MI/chest pain" (n = 372) were also examined, regardless of whether their corresponding discharge diagnosis was assigned as a stroke, MI, or an unrelated diagnosis. Comparing "CVA/stroke" with "rule out MI/ chest pain," mean EMS transport times were similar for arrival time, scene time, transport time, and total call time (Table 3).

DISCUSSION

Timely access to medical care for acute stroke and MI patients includes several steps: rapid recognition of the problem by the patient or bystander, contact with and access to medical care, identifying the problem at the highest level of emergency, transportation to the emergency department, evaluation in the emergency department, and initiation of appropriate treatment.[4] A significant delay in any step results in limiting treatment options for patient care. This study found that the time it takes for EMS to arrive at the scene after a 911 call is received by dispatchers was short and represented a small portion of the total prehospital delay reported in the literature for both stroke[5] and MI[6] patients. However, for patients with a stroke or MI discharge diagnosis, the mean total call time was approximately 44 minutes, which represents a clinically significant portion of the treatment window, especially for ischemic stroke patients (three hours). Lights and sirens to the scene decreased arrival, scene, and total call times for stroke and MI patients, which may be due to heightened urgency because of the higher dispatch priority.

The use of EMS is generally associated with earlier arrival to the hospital for both stroke[7–13] and MI[14–16] patients. For stroke patients, use of 911 is also associated with decreased in-hospital times, such as time to emergency physician evaluation,[7,8,11,17,18] time to a computed tomography (CT) scan,[8,17] and time to neurology consultation.[8] For MI patients, prolonged prehospital delay is an independent predictor of longer in-hospital delay.[15] Despite the importance of EMS in identifying, treating, and transporting patients, few data exist on how well the system meets these needs.[18] The EMS designation for stroke has historically not been placed at the highest response level, although an acute life support response for stroke is appropriate.[19]

This study found that transport times did not significantly differ between stroke and MI patients. Although the differences between stroke and MI are numerous, we chose to compare their EMS times due to the similarities of the populations at risk and the availability of emergent treatment.[20] Several points must be considered when making comparisons across these diagnoses. First, the tissue plasminogen activator (t-PA) treatment time window for ischemic stroke is within three hours of symptom onset,[21] yet for MI it may be up to 12 hours.[22] Although the earlier thrombolytics are administered in the case of MI, the greater the reduction in infarct size.[23] Second, the delays associated with the clinical diagnosis of acute ischemic stroke (e.g., CT scan required) are often greater than those associated with the diagnosis of acute MI.[24] Third, patients with MI typically present with more focal or localized symptoms, which often include pain, while stroke patients can present with vague symptoms, often with impaired communication and perception without pain.[4]

LIMITATIONS

Several limitations to this study should be acknowledged. The dispatcher processing time was not collected, but is likely to be less than 2 minutes. Triage algorithms were used to identify and prioritize patients by dispatchers, which may provide more timely and efficient quality of care. It is not known how response times may have changed if this system was not in place. In the multivariable models we were unable to control for distance (i.e., mileage) to the scene and to the hospital, which probably varied widely due to the geographic area covered by this single EMS system. Also, severity was not directly controlled for as a potential confounder in the analyses, although triage and use of lights and sirens may have served as a proxy for it. Additionally, using hospital discharge codes to define stroke or MI will likely misclassify some cases, more often for stroke.[25,26] than for MI patients.[27] Our definition of stroke combined both hemorrhagic and ischemic stroke events, due to limited statistical power to examine them separately. The generalizability of these findings is limited because it included only one county EMS system with a relatively advanced dispatch system. These findings should be confirmed in other EMS settings.

CONCLUSION

In this single county, almost half of stroke patients were dispatched as having "CVA/stroke" and almost half of MI patients were dispatched as "rule out MI/chest pain." The EMS response times were not different comparing stroke and MI patients identified either by dispatch chief complaint or by discharge diagnosis. However, any delay in elapsed EMS time represents a greater proportion of the thrombolytic treatment window for ischemic stroke as compared with MI patients. Approximately one fourth of the calls for both stroke and MI patients were treated nonurgently. Additionally, the scene time represented the largest EMS time interval for both stroke and MI patients and may offer the greatest opportunity for reducing total call time. The EMS system is a crucial part of the chain of recovery for both stroke and MI. While there appears to be little difference between stroke and MI transport times, these times were a significant part of the therapeutic window, leaving open important areas for improvement through intervention in the care of these patients. A comprehensive intervention for EMS personnel should include training in recognition of stroke and MI diagnoses, as well as acting with speed and urgency in the treatment and transport of these patients.

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SIRENS

Winter's Depression

Jingle Blues. Jingle Blues, Jingling
all the way. Mostly night,
sometimes day.

No what fun it is to ride Dr. Rosen's one-horse
open chaise, jingling jingling all the way.

I pay Dr. Rosen all my dough. Let it snow.
Let it snow. Let it snow.

Up and down I go, a Bi-Polar bear
slip-sliding the snow.

Jingle Blues. Jingle Blues.
So Dr. Rosen can pay AMA dues.

Dr. Rosen, with your mouth hung open,
it makes you look so frozen.
Dr. Rosen! Give me a pill. Send me the bill.
Dr. Rosen! Dr. Rosen!

DR. ROSEN!

DON SHIELDS, PhD
Maquoketa, Iowa