Effectiveness of emergency physician determinations of the need for thrombolytic therapy in acute stroke

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ABSTRACT

An increased emphasis on stroke care has led to a proliferation of specialized stroke teams despite relatively few trials demonstrating their efficacy. Our academic stroke center incorporated a unique setup allowing for the comparison between stroke teams and emergency physicians. During weekday working hours, a stroke team would respond to the emergency department for stroke activations. During all other times, the emergency physician caring for the patient would make all treatment decisions. We sought to determine whether there was any difference in treatment and outcomes between these two groups. We conducted a retrospective review of all stroke activations from January 2015 to June 2016 and compared the thrombolytic administration rates, modified Rankin Scale (mRS) at discharge, and change in National Institutes of Health Stroke Scale (NIHSS). A total of 415 stroke activations were identified. Of those, 69 of 262 patients (26.3%) seen by emergency physicians and 60 of 153 patients (39.2%) seen by neurologists received thrombolysis ($P = 0.006$). No significant difference was found in the discharge mRS or change in NIHSS between the two groups. Emergency physicians administered significantly less thrombolytics than did neurologists. No significant difference was observed in outcomes, including mRS and admission-to-discharge change in NIHSS.

KEYWORDS Brain infarction; emergency medicine; patient care team

Acute ischemic stroke is an often devastating disease process for which no clearly effective treatment options existed until recent years. A proliferation of studies has evaluated the effectiveness, risks, and ideal timing of thrombolytic and endovascular interventions for treating acute ischemic stroke.^{1–5} Specialized stroke care teams have emerged to conquer the complexity of rapidly changing and often controversial stroke treatment guidelines. Despite the widespread use of said teams, little evidence supports their implementation and their associated increase in health care costs. In response to the increased focus on door-to-needle times, a few small observational studies have reported that individual institutions have improved treatment time by parallel implementation of multiple systemwide measures, including extensive personnel training, simulation, rapid triage stroke protocols, direct transportation to a computed tomography (CT) scanner,

hospitalwide stroke algorithms, and the formation of neurologist-led stroke teams.^{6,7} Although evidence supports the use of many of these measures in conjunction, to our knowledge no current evidence demonstrates the specific effect that a neurologist-led stroke team has on patient outcomes or door-to-needle times.

METHODS

All study methods and procedures were reviewed and approved by our local institutional review board. We retrospectively reviewed electronic medical records of all patients meeting stroke activation criteria who presented to the emergency department (ED) from January 1, 2015, to June 30, 2016. During this time, our medical center implemented a neurologist-led stroke team that was available during regular business hours Monday through Friday. During evenings, nights, and weekends, the same stroke algorithms and other

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Table 1. Patient characteristics

Category	Variable	Emergency physician (<i>n</i> = 261) ^a		Stroke team (<i>n</i> = 153) ^a		<i>P</i> value
		<i>n</i>	% ^b	<i>n</i>	% ^b	
Demographics	Age (years)	62	53–77	64	54–76	0.964
	Male	127	49%	67	44%	0.338
	Female	134	51%	86	56%	
Past medical history	Hypertension	178	68%	97	63%	0.345
	Smoker	35	13%	21	14%	0.916
	Diabetes	188	72%	113	74%	0.644
Mode of arrival	Private vehicle	64	24%	39	25%	0.295
	Intrahospital	1	<1%	3	2%	
	Other (including ambulance)	197	75%	111	72%	
NIHSS score	Initial measurement (points)	7	3–14	6	2–15	0.490
ED diagnosis	Hemorrhagic	30	11%	10	7%	0.170
	Ischemic	175	67%	116	76%	
	Neurological/psychiatric	42	16%	21	14%	
	Other	13	5%	4	3%	

ED indicates emergency department; NIHSS, National Institutes of Health Stroke Scale.

^aIn ED group, *n* = 262 for age, *n* = 260 for ED diagnosis. In stroke team group, *n* = 151 for ED diagnosis.

^bContinuous variables reported as median and 25th to 75th percentile range rather than percentage.

systems remained in place with the exception of the neurologist-led stroke team. During business hours, the decision to treat with thrombolytic therapy (i.e., tissue plasminogen activator [tPA]) was made by the neurology staff physician leading the stroke team. During all other times, the decision was left to the emergency physician. Keeping other potential confounding variables constant, this study compared the management decisions and patient outcomes of the neurologist-led stroke team and emergency physicians.

The primary objective of the study was to compare the tPA administration rates of the neurologist-led stroke team and emergency physicians. The secondary objectives were to compare door-to-needle times, modified Rankin Scale (mRS) at discharge, change in National Institutes of Health Stroke Scale (NIHSS), and discharge disposition.

The study was conducted at a large academic level 1 trauma and stroke center in the United States with an annual ED census of about 75,000 patients. To reduce selection bias and keep results applicable to the broad range of undifferentiated stroke-like symptoms seen in the ED, all patients who were identified by either prehospital or hospital personnel as meeting predefined stroke activation criteria were included, regardless of final diagnosis.

All desired study variables were determined before data abstraction. Institutional stroke database records were used to obtain demographic data, comorbidities, time to CT, tPA administration rate, door-to-needle times, NIHSS at

admission and discharge, mRS at time of discharge, final disposition, and mortality. The primary outcome was rate of tPA administration and secondary outcomes included, among others, door-to-needle time, change in NIHSS, mRS at discharge, and discharge disposition.

After all appropriate study data were collected, data analysis was performed using SAS version 9.4. Demographic characteristics were summarized using descriptive statistics. Frequencies and percentages were provided for categorical variables. Means and standard deviations, or medians and ranges when appropriate, were provided for continuous variables. Fisher's exact and chi-square tests compared demographics by treatment team. Chi-square and Wilcoxon rank sum tests compared differences between tPA administration and outcomes. The significance level was set at *P* < 0.05. The institution's statistics team conducted all data analyses.

RESULTS

Of the 415 patients who met stroke activation criteria from January 1, 2015, to June 30, 2016, 262 were treated by emergency physicians and 153 were managed by the neurologist-led stroke team. No significant differences in demographic characteristics, initial NIHSS, or discharge diagnosis were noted between the two groups (Table 1).

The distribution of the time from arrival at the ED to initial NIHSS documentation was significantly different (*P* = 0.002). Our data showed shorter average times for

Table 2. Comparison of interventions, including rate of tissue plasminogen activator administration and stroke outcome measures

Category	Variable	Emergency physician		Stroke team		P value
		n	% ^a	n	%	
Mean door-to-task time (min)	First blood pressure	5	3–8	5	3–10	0.354
	Initial assessment	6	3–12	6	3–13	0.961
	Initial NIHSS	10	6–18	15	8–25	0.002*
	Electrocardiogram	20	10–36	28	12–42	0.029*
	CT order	7	4–11	6.5	4–11	0.212
	CT initiated	21	15–29	18	13–26	0.043*
	CT result	31.5	25–40	27.5	22–36	0.002*
	Labs	44	36–55	42	36–54	0.640
Intervention		N= 262		N= 153		
	Thrombolytic administration ^b	69	26	60	39	0.006*
	Door-to-needle time (min) ^a	52	37–70	43.5	36–53	0.036*
Discharge mRS		N= 104		N= 69		0.441
	0	13	13%	11	16%	
	1	12	12%	15	22%	
	2	9	9%	7	10%	
	3	9	9%	4	6%	
	4	37	36%	19	28%	
	5	17	16%	7	10%	
	6	7	7%	6	9%	
Discharge disposition		N= 122		N= 83		0.250
	End-of-life care	10	8%	4	5%	
	Long-term care	47	39%	25	30%	
	Home from inpatient	57	47%	44	53%	
	Home from ED	0	0%	3	4%	
	Death	7	6%	6	7%	
	AMA	1	1%	1	1%	
NIHSS (points)	Discharge	3	0–8	2	0–7	0.439
	Change	2	0–6	2	0–6	0.740
Length of stay	Days to discharge	3	2–6	3	2–5	0.020 ^b

AMA indicates against medical advice; CT, computed tomography; EM, emergency department; mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale.

*Statistically significant.

^aContinuous variables reported as median and 25th to 75th percentile range rather than n, %.

^bDespite similar median values, statistical significance achieved due to outliers skewing the mean values of the ED group.

patients treated by the neurologist-led stroke team compared to patients treated by emergency physicians (13.9 vs 18.5 min). Time to CT result (30.6 vs 34.2 min, $P=0.002$), door-to-needle times (47.4 vs 55.9 min, $P=0.036$), and days to discharge (3.65 vs 4.93 days, $P=0.020$) were also significantly different. Again, our data showed shorter times for patients in the neurologist-led stroke team group (*Table 2*).

The difference in the rate of tPA administration between the neurologist-led stroke team and emergency physician groups (39% and 23%, respectively) was statistically significant ($P=0.007$). However, no statistically significant difference was noted in discharge mRS ($P=0.441$), discharge NIHSS (5.21 vs 5.99, $P=0.439$), admission-to-discharge change in NIHSS (3.77 vs 3.74, $P=0.740$), or discharge disposition ($P=0.250$).

DISCUSSION

Although treating acute ischemic stroke with thrombolytics has remained controversial, the approach appears to be viewed positively.⁸ At the same time, with intense focus on rapid benchmark-based care, concern has been raised that treating stroke mimics with thrombolytics⁹ could expose patients to significant risk of intracranial hemorrhage³ without providing any expected benefit. Multiple studies have evaluated multifaceted approaches to improving door-to-needle times and stroke treatment outcomes through measures such as specific stroke protocols, stroke activation criteria, prehospital notification, direct transport to CT, thrombolytic administration during imaging, and neurologist-led stroke teams.^{10–14} Some studies have reported on the implementation of stroke teams in conjunction with multiple other measures.¹⁵ However, to our knowledge, no study has attempted to isolate the specific effect that a neurologist-led stroke team can have on either stroke outcomes or door-to-needle times. Our study attempted to isolate the effects of a neurologist-led stroke team from emergency physician care while keeping all other variables constant.

In our retrospective review, we found no difference in discharge mRS, discharge NIHSS, change in NIHSS from admission to discharge, or discharge disposition between the two different teams. When interpreting these hospital-based outcomes, it is important to note that the original National Institute of Neurological Disorders and Stroke study did not find benefit until 3 months after stroke.⁵ We also identified lower rates of tPA administration and slightly longer time to obtaining imaging, initial NIHSS documentation, and door-to-needle administration by emergency physicians compared to the neurologist-led stroke team. These data suggest that implementation of a neurologist-led stroke team may slightly improve door-to-needle times but does not directly improve efficacy or outcomes of acute ischemic stroke treatment. Additionally, with rates of thrombolytic administration causing concerns about inappropriate treatment of stroke mimics, the increased rate of tPA administration among neurologist-led stroke teams requires further investigation and may suggest that emergency physicians are qualified at evaluating stroke mimics.

Our study is limited to a single institution with a unique stroke care system, so it may not be applicable to all institutions. The retrospective nature of our study further limits its application, preventing any direct assessment of causality. The temporal nature of our study (i.e., the neurologist-led stroke team treating during daytime hours and emergency physicians treating during nights and weekends) may have led to unforeseen differences in daytime and nighttime factors, such as ED ancillary staffing. Additionally, we were unable to reliably obtain data regarding postthrombolytic complication rates (including hemorrhage) and the percentage of patients who underwent thrombectomy. Finally, although evidence of lower thrombolytic administration rates may suggest a decrease in inappropriate treatment of stroke

mimics, we did not obtain any data to compare the rates of stroke mimic treatment between the two groups.

In conclusion, despite widely accepted clinical guidelines calling for the rapid treatment of acute ischemic stroke with thrombolysis, debate regarding its efficacy and safety continues.¹⁶ When considering institutional practices and processes to decrease door-to-needle times, it is imperative to consider each measure's evidence and overall effect on patient outcomes. Our study, though limited, suggests that emergency physicians may not be inferior to neurologist-led stroke teams in the evaluation and treatment of acute ischemic stroke. Further prospective, multicenter studies are needed to evaluate the efficacy of and need for neurologist-led stroke teams in the treatment of acute ischemic stroke.

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