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Weekday Versus Weekend Presentation in the Acute Management of Ischemic Stroke Through Telemedicine

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Abstract

A "weekend effect" resulting in higher mortality rates for patients with stroke admitted on weekends has been reported. We examine this phenomenon for patients with acute ischemic stroke (AIS) presenting to telestroke (TS) sites to determine its effect on stroke alert process times and outcomes. From October 2015 to June 2017, we reviewed patients with AIS receiving intravenous alteplase within our TS network. We compared patients presenting to TS sites on weekdays (Monday 07:00 to Friday 18:59) to those presenting on weekends (Friday 19:00 to Monday 06:59). We analyzed door-to-alert activation, alert activation-to-TS evaluation, door-to-imaging, and door-to-needle times. Rates of favorable outcome (modified Rankin Scale score ≤ 2) and death at 90 days were compared. We identified 89 (54 weekday and 35 weekend) patients (mean age: 71.8 $\pm$ 13.3 years, 47.2% women) during the study period. Median door-to-alert activation ($P = .01$) and door-to-needle ($P = .004$) times were significantly longer for patients presenting on weekends compared to weekdays. There were no significant differences in median door-to-imaging ($P = .1$) and alert activation-to-TS evaluation ($P = .07$) times. Rates of favorable outcome ($P = .19$) and death ($P = .56$) at 90 days did not differ. While there were no significant differences in outcomes, patients presenting on weekends had longer door-to-alert activation and door-to-needle times. Efforts to improve methods in efficiency of care on weekends should be considered.

Keywords

stroke, telemedicine, telestroke, weekend effect

Introduction

Stroke continues to be a leading cause of death and disability in the United States, and geographic disparities in mortality rates continue to exist.[1,2] A significantly lower proportion of patients receive intravenous (IV) alteplase within rural communities when compared to patients in urban communities.[2] The implementation of telestroke (TS) provides immediate access to stroke experts, helping to treat eligible patients having stroke with IV alteplase safely.[3,4]

Stroke hospital admissions on weekends when compared to weekdays results in higher mortality rates, which has been referred to as the "weekend effect." The existence of stroke center designation seems to eliminate this phenomenon.[5] However, over half of Americans are at least an hour away from the closest stroke center, which leads to many patients being treated at nondesignated hospitals prior to transfer to stroke centers for postalteplase care.[6,7] We sought to determine the impact of day of presentation on outcomes for patients with acute ischemic stroke (AIS) receiving IV alteplase at rural-based hospitals where TS is available.

Methods

From October 2015 to June 2017, we retrospectively reviewed consecutive patients with AIS treated with IV alteplase at TS sites identified from a prospective database. We compared outcomes of patients presenting on weekdays (Monday 07:00 to Friday 18:59 hours) to patients presenting on weekends (Friday 19:00 to Monday 06:59 hours). This study was

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Table 1. Baseline Characteristics and Time Metrics for Patients Based on Day of Presentation.

	Weekday (54)	Weekend (35)	P
Mean age (SD)	70.5 (13.7)	73.9 (12.7)	.38
No. of women (%)	27 (50)	15 (42.9)	.51
Admission NIHSSS, median [IQR]	5 [2, 15]	6 [3, 16]	.5
Door to stroke alert activation, minutes, median [IQR]	8 [1, 17]	15 [3, 16]	.01
Stroke alert to TS evaluation, minutes, median [IQR]	5 [4, 9]	7 [5, 10]	.07
Door to imaging, minutes, median [IQR]	11 [6, 21]	17 [7, 32]	.1

Abbreviations: IQR, interquartile range; NIHSSS, National Institutes of Health Stroke Scale score; SD, standard deviation; TS, telestroke.

approved by our institutional review board. During the study period, our TS practice consisted of 5 neurologists providing around-the-clock coverage to 15 hospitals.

We reviewed medical records of patients to determine the severity of neurological deficit at presentation as defined by the National Institutes of Health Stroke Scale score (NIHSSS). Time metrics analyzed include: (1) door to needle, (2) door to stroke alert activation, (3) stroke alert activation to neurologist evaluation via TS, and (4) door to imaging. Primary outcomes studied were median door-to-needle time (DNT) and rate of 90-day mortality. Secondary outcomes included proportion of patients with DNTs $\leq$60 minutes and rates of orolingual angioedema (OAE), symptomatic intracerebral hemorrhage (sICH) as defined by NIHSSS increase $\geq$4, and favorable outcome as defined by modified Rankin Scale (mRS) score $\leq$2. The mRS scores available were collected from telephone interviews or face-to-face encounters.

Statistical analysis was performed using SAS software (version 9.4; SAS Institute, Cary, North Carolina). Statistics were expressed as means with standard deviations, medians with interquartile ranges, and frequency (percentages). Continuous variables were analyzed by Wilcoxon rank-sum test, and categorical variables were analyzed by χ^2 test.

Results

We identified 89 (54 weekday and 35 weekend) patients (mean age: 71.8 $\pm$ 13.3 years, 47.2% women) during our study period. There were no differences in age ($P = .38$), gender ($P = .51$), or admission NIHSSS ($P = .5$) based on the day of presentation (Table 1). Comorbidities were not different between groups (data not shown). Median door-to-stroke alert activation time (15 [3, 16] vs 8 [1, 17] minutes, $P = .01$) and DNT (61 [48, 74] vs 47 [35, 59] minutes, $P = .004$) were longer for patients presenting on weekends compared to weekdays. A lower proportion of weekend patients had DNT $\leq$60 minutes when compared to weekday patients (48.6% vs 75.9%, $P = .009$). There were no differences in door-to-imaging (weekend 17 [7, 32] vs weekday 11 [6, 21] minutes, $P = .1$) or stroke alert activation-to-TS evaluation (weekend 7 [5, 10] vs weekday 5 [4, 9] minutes, $P = .07$) times. The rate of sICH was not different (weekend 2.9% vs weekday 3.7%, $P = .83$). One case of OAE occurred among all patients studied. No difference existed for rates of favorable outcomes (weekend 50% vs weekday 66.7%, $P = .19$) or mortality (weekend 8.3% vs weekday 4.8%, $P = .56$) at 90 days (Table 2).

Table 2. Outcomes of Patients Based on Day of Presentation.

	Weekday (54)	Weekend (35)	P
Door-to-needle time, minutes, median [IQR]	47 [35, 59]	61 [48, 74]	.004
Door to needle $\leq$60 minutes	75.9%	48.6%	.009
Symptomatic ICH	3.7%	2.9%	.83
Orolingual angioedema	1	0	-
90-day mRS $\leq$2	66.7% (n = 42)	50% (n = 24)	.19
90-day mortality	4.8% (n = 42)	8.3% (n = 24)	.56

Abbreviations: IQR, interquartile range; ICH, intracerebral hemorrhage, mRS, modified Rankin Scale.

Discussion

Patients admitted to hospitals over the weekend have higher mortality rates.[8] For patients with AIS, this "weekend effect" can be eliminated with care provided at stroke centers.[5] However, many patients do not have immediate access to stroke centers and receive care at nonstroke center designated facilities.[6] Moreover, eligible patients with AIS are less likely to receive IV alteplase in rural settings when compared to urban counterparts.[2] The immediate access to stroke experts via the implementation of TS could increase IV alteplase utilization at these sites.

We found no effect on outcomes among our TS patients receiving IV alteplase based on the day of presentation. There were also no significant differences in rates of immediate complications associated with IV alteplase use, including sICH and OAE. While the "weekend effect" typically refers to mortality, we evaluated DNTs as well because the timeliness of thrombolytic treatment is directly related to outcomes.[9] We discovered that there were significantly longer DNTs on weekends, which resulted in a significantly lower proportion of patients being treated $\leq$60 minutes of arrival to the hospital.

In our study, IV alteplase initiation delays on weekends were related to significantly longer door-to-stroke alert activation times. We were unable to identify specific reasons for the weekend delays in stroke alert activations but speculate that differences in personnel or staffing models could play a role at these with limited resources for acute care. Previously reported delays in IV alteplase initiation were largely related to the time elapsed from patient arrival to initiation of TS

consultation request, which invariably leads to delays in neurologist assessments and recommendations.[10] Findings in our study confirms this. We know that rapid stroke team notification is independently associated with shorter DNTs,[11] but despite this treatment delay, we did not observe significant differences in outcomes at 90-day follow-up visits.

Our study was restricted to patients with AIS who received IV alteplase in the emergency department setting. An increase in in-hospital mortality among all patients with stroke has been reported,[12] which suggests that outcomes may be affected by care received outside the emergency setting and among patients who do not qualify for acute stroke treatments. Our TS practice ensures that stroke expertise is available in the acute setting during all hours of the day, which results in a higher proportion of patients receiving IV alteplase $\leq$60 minutes of arrival to the hospital when compared to other TS practices.[13] A similar study was performed evaluating the effects of weekend and after-hour presentation on the acute treatment of ischemic stroke; however, generalizability is limited as the study was performed in an academic setting where trainees were involved in the care of patients studied.[14]

Our study has important limitations. While data were prospectively collected, our analysis was retrospectively performed. The small sample size and low number of adverse events decrease the power to detect meaningful differences in outcomes. Because our analysis was restricted to AIS receiving IV alteplase, our results are not generalizable to all patients with stroke. We were also not able to ascertain the resources available between the 2 cohorts compared. Finally, almost 26% of our patients were lost to follow-up.

While there were no significant differences in outcomes, we found that patients presenting on weekends have longer DNTs as a result of longer door-to-stroke alert activation times. Further quality improvement efforts should be considered to help facilitate faster treatment times on the weekends in order to increase chances of favorable outcomes. Additional investigations of outcomes among all patients with stroke admitted to rural facilities with TS-directed care will be needed to help guide future quality improvement endeavors.

Declaration of Conflicting Interests

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