Decline in Stroke Presentations During COVID-19 Surge

Ken Uchino, MD; Murali K. Kolikonda, MBBS; Dena Brown, MSN, RN; Shivakrishna Kovi, MBBS; Dana Collins, MBA; Zeshaun Khawaja, MD; A. Blake Buletko, MD; Andrew N. Russman, DO; M. Shazam Hussain, MD

BACKGROUND AND PURPOSE: We aimed to investigate the acute stroke presentations during the coronavirus disease 2019 (COVID-19) pandemic.

METHODS: The data were obtained from a health system with 19 emergency departments in northeast Ohio in the United States. Baseline period from January 1 to March 8, 2020, was compared with the COVID period from March 9, to April 2, 2020. The variables included were total daily stroke alerts across the hospital emergency departments, thrombolysis, time to presentation, stroke severity, time from door-to-imaging, time from door-to-needle in thrombolysis, and time from door-to-puncture in thrombectomy. The 2 time periods were compared using nonparametric statistics and Poisson regression.

RESULTS: Nine hundred two stroke alerts during the period across the emergency departments were analyzed. Total daily stroke alerts decreased from median, 10 (interquartile range, 8–13) during baseline period to median, 8 (interquartile range, 4–10, \( P = 0.001 \)) during COVID period. Time to presentation, stroke severity, and time to treatment were unchanged. COVID period was associated with decrease in stroke alerts with rate ratio of 0.70 (95% CI, 0.60–0.28). Thrombolysis also decreased with rate ratio, 0.52 (95% CI, 0.28–0.97) but thrombectomy remained unchanged rate ratio, 0.93 (95% CI, 0.52–1.62)

CONCLUSIONS: We observed a significant decrease in acute stroke presentations by ≈30% across emergency departments at the time of surge of COVID-19 cases. This observation could be attributed to true decline in stroke incidence or patients not seeking medical attention for emergencies during the pandemic.

Key Words: coronavirus | emergency | incidence | pandemic | stroke | thrombectomy

The coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 has become global pandemic in early 2020. Although COVID-19 may be associated with cerebrovascular and cardiovascular complications, a significant reduction in presentations of ST-segment–elevation myocardial infarction has been reported during the pandemic period. We aimed to analyze pattern of acute stroke presentations during the pandemic across a regional health system in the United States in relation to the surge of COVID-19 cases.

METHODS

The health system located in the Northeast Ohio region in the United States included 19 emergency departments (EDs) as a part of 1 comprehensive stroke center, 3 thrombectomy capable stroke centers, 7 primary stroke centers, 2 nonstroke center hospitals, 6 free standing EDs, of which 13 sites received acute stroke care through telemedicine. The baseline period was from January 1 to March 8, 2020, and COVID period was defined as starting March 9, the date of the declaration of state emergency in Ohio. We analyzed data through April 2, 2020. The study data are available from the corresponding author upon reasonable request.

The health system maintains centralized data regarding stroke care for quality and administrative purposes. We queried stroke alerts, telemedicine activation, and thrombolysis and thrombectomy for ischemic stroke and obtained the date and site, stroke characteristics of time to presentation from last known well in minutes, severity measured by National Institutes of Health Stroke Scale score, and hospital response characteristics door-to-CT completion time, door-to-needle time among thrombolysis.
and door-to-arterial puncture time in minutes. Among stroke alerts, we determined whether diagnosis of stroke was made in ED, defined as ischemic or hemorrhagic stroke or symptoms consistent with stroke recorded as the first diagnosis of impression in ED note. The number of COVID-19 cases was obtained from the Ohio Department of Health for northeast Ohio. 6

Daily and weekly counts of stroke alerts and other events were calculated. We conducted subgroup analyses among stroke alerts by type of ED (comprehensive stroke center and other) and stroke diagnosis in ED. Wilcoxon rank-sum tests and Fisher exact tests were used. Medians and interquartile ranges (IQRs) for continuous variables are compared between the 2 time periods. Poisson regression was performed with daily counts as the dependent variable with study period and weekday as independent variables. The study was conducted without collection of patient identifiable information from data already collected and was approved by the institutional review board.

RESULTS

Between January 1 and April 2, 2020, a total of 1656 COVID-19 cases were confirmed in Northeast Ohio region (Figure). A total of 902 stroke alerts (717 in baseline, 185 in COVID periods), 496 stroke telemedicine activations (397 in baseline, 99 in COVID periods), 74 thrombolyses (62 in baseline, 12 in COVID periods), and 59 thrombectomies (44 in baseline, 15 in COVID periods) were analyzed.

The daily stroke alerts within the system significantly decreased from baseline period (median, 10 [IQR, 8–13]) to COVID period (median, 8 [IQR, 4–10], P=0.001; Table 1). Daily stroke alerts at the comprehensive stroke center ED as well as other EDs and ED diagnosis of stroke similarly declined. Stroke telemedicine activations also decreased from the baseline period (median, 5.5 per day [IQR, 4–7.75], to COVID period (median, 4 per day [IQR, 3–5], P=0.02). The daily administration of thrombolysis within the system was also decreased from the baseline period (median, 1 [IQR, 0–2]) to COVID period (median, 0 [IQR, 0–1], P=0.03), but thrombectomies remained unchanged.

There was no significant delay in time to presentation among stroke alerts from baseline period (median, 114.5 [IQR, 50–404]) to COVID period (median, 160 [IQR, 43.5–430.5], P=0.63) or among the subgroup of patients with stroke diagnosis in ED. Stroke severity measured by National Institutes of Health Stroke Scale score did not change in the overall stroke alerts from baseline period (median, 3 [IQR, 1–7]) to COVID period (median, 3 [IQR, 1–9], P=0.435), or among subgroups of those with ED stroke diagnosis, receiving thrombolysis, or receiving thrombectomy (Table in the Data Supplement).
In-hospital process times showed no clear delay. The door-to-CT completion time from the baseline period (median, 27 [IQR, 15–55]) to COVID period (median, 22.5 [IQR, 14–50.75], \( P = 0.30 \)) was not affected. Similarly, door-to-needle time for thrombolysis cases was unchanged from the baseline period (median, 46 [IQR, 35.75–59.75]) to COVID period (median, 37 [IQR, 30.75–58], \( P = 0.23 \)).

Poisson regression showed the COVID period was associated with a reduction in acute stroke presentations with rate ratio, 0.70 (95% CI, 0.60–0.83), for stroke alerts, 0.74 (95% CI, 0.59–0.92), for stroke telemedicine activation, 0.74 (95% CI, 0.62–0.88) for ED stroke diagnosis among stroke alerts (Table 2). The rate ratio for thrombolysis was 0.52 (95% CI, 0.28–0.97), but thrombectomy showed no significant reduction, rate ratio, 0.93 (95% CI, 0.52–1.68).

**DISCUSSION**

We observed a 26% to 30% reduction in acute stroke presentations in EDs, as measured by total stroke alerts, ED stroke diagnosis among stroke alerts, and stroke telemedicine activations during the surge of COVID-19 outbreak in our region. State emergency declaration resulted in public health measures of school closures, restaurant closures, social distancing, and stay-at-home orders. The cause of the observed decline in stroke presentations is unknown. This observation could be attributed to a true decline in the stroke incidence or patients not seeking medical attention for emergencies during the pandemic. Our study supports some of the previous observations of the SARS outbreak in 2003 which resulted in a marked reduction in the number of ED visits. Fear of contracting the COVID-19 disease by presenting to hospitals may have led to the reduction in stroke presentations. Contrary to our expectation that patients with milder strokes would stay home, we did not see a change in severity of stroke presentations.

We did not observe clear delays in in-hospital treatment, which might be expected with taking infectious precautions in EDs. During the study period, there were no overwhelming number of COVID-19 cases, and the study may be underpowered to detect the change.

### Table 1. Stroke Volumes, Characteristics, and Quality Measures

|                      | Baseline Period January 1–March 8 | COVID Period March 9–April 2 | \( P \) Value |
|----------------------|-----------------------------------|-----------------------------|--------------|
| **Daily volume**     |                                   |                             |              |
| Stroke alerts per day| 10 (8–13)                         | 8 (4–10)                    | 0.001        |
| Stroke alerts at CSC ED per day | 2 (1–2)                       | 1 (0–2)                     | 0.01         |
| Stroke alerts not at CSC per day | 8 (6–11)                        | 7 (4–8)                     | 0.003        |
| ED stroke diagnosis per day | 8 (6–11)                        | 6 (4–8)                     | 0.01         |
| Stroke telemedicine per day | 5.5 (4–7.75)                    | 4 (3–5)                     | 0.02         |
| Thrombolysis per day | 1 (0–2)                          | 0 (0–1)                     | 0.03         |
| Thrombectomy per day | 0 (0–1)                          | 0 (0–1)                     | 0.94         |
| **Stroke characteristics** |                                   |                             |              |
| Time to presentation since last known well in minutes | 114.5 (50–404)               | 160 (43.5–430.5)            | 0.63         |
| Known time of stroke onset, proportion (%) | 425/714 (60%)                | 124/188 (66%)               | 0.11         |
| Stroke severity by NIHSS | 3 (1–7)                          | 3 (1–9)                     | 0.44         |
| **Hospital response characteristics** |                                   |                             |              |
| Door-to-CT completion time in minutes | 27 (15–55)                  | 22.5 (14–50.75)             | 0.30         |
| Door-to-needle time in minutes | 46 (35.75–59.75)            | 37 (30.75–58)               | 0.23         |
| Door-to-needle time ≤ 45 min, proportion (%) | 30/62 (48%)                  | 8/12 (77%)                  | 0.35         |
| Door-to-puncture time in minutes | 67 (35–116)                 | 84 (68–166)                 | 0.067        |
| Door-to-puncture ≤ 90 min, proportion (%) | 29/44 (66%)                  | 8/15 (53%)                  | 0.54         |

Median value (interquartile range), unless noted. COVID indicates coronavirus disease; CSC, comprehensive stroke center; ED, emergency department; and NIHSS, National Institutes of Health Stroke Scale.

### Table 2. Rate Ratios by Poisson Regression

|                      | Stroke Alerts | Stroke Telemedicine | Stroke Diagnosis in Emergency Department | Thrombolysis | Thrombectomy |
|----------------------|---------------|--------------------|------------------------------------------|--------------|--------------|
| **COVID period: baseline period** | 0.70 (0.60–0.83) | 0.74 (0.59–0.92) | 0.74 (0.62–0.88) | 0.52 (0.28–0.97) | 0.93 (0.52–1.68) |
| Weekend: weekday      | 0.73 (0.62–0.85) | 0.96 (0.79–1.17) | 0.75 (0.63–0.88) | 0.80 (0.47–1.37) | 1.12 (0.65–1.96) |

Rate ratio (95% CI). COVID indicates coronavirus disease.
We acknowledge that the data are from a health system in northeast Ohio and do not represent true population-based data in a global pandemic. Stroke alerts and stroke telemedicine data represent different sources of data within the health system. And our finding is consistent with a report of ST-segment–elevation myocardial infarction in the United States.\textsuperscript{2} As our data are from the early phase of the COVID-19 epidemic in the region, we await further data from other regions and data sources. The numbers of COVID-19 cases underestimate the incidence since test capacity limited ascertainment. This study underestimates the hemorrhagic stroke presentations because those without stroke-like focal deficits are not included in stroke alerts or stroke telemedicine.

CONCLUSIONS

We observed a significant decrease in stroke presentations across the health system at the time of the initial surge of COVID-19 cases in Northeast Ohio. We await the evolution of full impact of COVID-19 pandemic on stroke during the coming months.

ARTICLE INFORMATION

Received April 20, 2020; accepted June 4, 2020.

Affiliation
Cerebrovascular Center, Neurological Institute, Cleveland Clinic, OH.

Acknowledgments
We thank the stroke coordinators and stroke program managers at Cleveland Clinic for collecting data and making them available.

Sources of Funding
None.

Disclosures
Dr. Uchino has received compensation from Ono Pharmaceutical Co, Lt., Portola, Inc, Abbott Laboratories, and Genentech, Inc, unrelated to this work. The other authors report no conflicts.

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