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Clinician's Perception of Practice Changes for Stroke During the COVID-19 Pandemic

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Background: Approach to acute cerebrovascular disease management has evolved in the past few months to accommodate the rising needs of the 2019 novel coronavirus (COVID-19) pandemic. In this study, we investigated the changes in practices and policies related to stroke care through an online survey. *Methods:* A 12 question, cross-sectional survey targeting practitioners involved in acute stroke care in the US was distributed electronically through national society surveys, social media and personal communication. *Results:* Respondants from 39 states completed 206 surveys with the majority (82.5%) from comprehensive stroke centers. Approximately half stated some change in transport practices with 14 (7%) reporting significant reduction in transfers. Common strategies to limit healthcare provider exposure included using personal protective equipment (PPE) for all patients (127; 63.5%) as well as limiting the number of practitioners in the room (129; 64.5%). Most respondents (81%) noted an overall decrease in stroke volume. Many (34%) felt that the outcome or care of acute stroke patients had been impacted by COVID-19. This was associated with a change in hospital transport guidelines (OR 1.325, P = 0.047, 95% CI: 1.004–1.748), change in eligibility criteria for IV-tPA or mechanical thrombectomy (MT) (OR 3.146, P = 0.052, 95% CI: 0.988–10.017), and modified admission practices for post IV-tPA or MT patients (OR 2.141, P = 0.023, 95% CI: 1.110–4.132). *Conclusion:* Our study highlights a change in practices and policies related to acute stroke management in response to COVID-19 which are variable among institutions. There is also a reported reduction in stroke volume across hospitals. Amongst these changes, updates in hospital transport guidelines and practices related to IV-tPA and MT may affect the perceived care and outcome of acute stroke patients.

Key Words: Acute Ischemic Stroke—Stroke management—COVID-19—Quality and Outcomes

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Introduction

Background and rationale

Acute stroke care is time sensitive and requires a prompt multidisciplinary approach for effective management. The essential components involve rapid decision making for the need of thrombolytic therapy and/or endovascular intervention, and then transfer to a center with a higher level of care as described in the “Hub and Spoke” model.¹ This model of practice allows for timely intervention for patients presenting at remote community hospitals and improves overall patient outcomes.²

As the 2019 novel coronavirus (COVID-19) pandemic continues to evolve, hospitals across the nation have implemented new policies and protocols to ensure the safety of patients and practitioners, and to conserve or reallocate resources. We sought to survey the stroke community across the nation to understand the current changes in stroke systems of care.

Objectives

The primary objective of this survey is to understand the changes in practices and policies related to acute stroke care during the COVID-19 pandemic. The secondary objective is to analyze the effect of these changes on the perceived impact of acute stroke care and patient outcome.

Methods

Study design and Setting

This is an IRB exempt, observational, population-based study led by researchers at The Ohio State University. A cross-sectional survey of twelve questions (Table 1) was distributed nationally to practitioners involved in management of acute stroke patients. Given the rapidly changing circumstances related to the COVID-19 pandemic within the United States, survey recruitment was completed in a three week period. The survey was distributed electronically between April 6, 2020 and April 26, 2020.

Table 1. Survey questions

Question
What is your role?
What is your area of specialty?
In which region do you practice?
What are the stroke capabilities at your institution?
Did your institutional guidelines for hospital transport change during the COVID-19 pandemic?
What procedures are still considered essential requiring transport to a comprehensive stroke center during the COVID-19 pandemic?*
Have stroke alert practices changed at your institution during the COVID-19 pandemic?*
Is there any change in eligibility criteria for tPA or thrombectomy to limit staff exposure and save resources for PUI or +COVID-19 patients?
Have you changed admission practices for post-tPA or thrombectomy patients during the COVID-19 pandemic?*
Has your Stroke and/or Neuro Intensive Care Unit been affected by the COVID-19 pandemic?*
Do you believe there has been a change in stroke volume at your institution in the setting of the COVID-19 pandemic?
Do you believe the outcome or care of stroke patients at your institution has been impacted in the setting of the COVID-19 pandemic?

*Select all that apply

The survey was disseminated in various ways including: 1) Neurocritical Care Society (NCS) survey taskforce after review and approval by the Research Operations Sub-Committee; 2) Promotion on three online Synapse communities of American Academy of Neurology (AAN) including a) Critical Care and Emergency Neurology Section Community, b) Endovascular and Interventional Neurology Section Community, and c) Stroke and Vascular Neurology Section Community; 3) Social media platforms (Twitter and Facebook); and 4) Emails to Vascular and Neurocritical Care Fellowship Directors within the United States. Data collection, recording and storage occurred on a password-protected web-based server: surveymonkey.com.

Participants

The intended participants for this survey were practicing and training physicians and advanced practice providers (APPs) on the front lines of stroke care. This included multiple specialties such as neurology, neurosurgery, internal medicine, and emergency medicine.

Survey bias

To minimize recall bias we created a descriptive and detailed set of questions that were internally peer-reviewed prior to distribution. We also targeted health care professionals that would be the most informed about these practice changes.

Statistical methods

Data were analyzed with SPSS 26 for windows. Descriptive statistics were used to report the characteristics of survey respondents. Attitudes about hospital transport, specialty unit utilization, stroke volume and patient outcomes were compared to demographic characteristics with a Chi-squared test. Binomial logistic regression analysis was conducted using questions regarding change in stroke practice as independent variables to identify factors associated with perceived change in outcome or care. Regression diagnostics were performed for each analysis. The statistical significance was set at $p < 0.05$ (two-sided). Odds ratios (ORs) and their 95% confidence intervals were used to quantify the associations between variables.

Results

Participants

We received a total of 206 responses with a 100% completion rate. Six surveys were excluded since the respondents were outside the target population (3 RNs, 2 pharmacists, one neuroscience coordinator). The respondents included 153 (76.5%) attending/practicing physicians, 75 (37.5%) vascular neurologists, and 56 (28%) neurocritical care specialists (Table 2). The majority

Table 2. Demographic data of survey participants

Question	Response	N (%)
Role	Attending Physician	153 (76.5)
	Trainee (Fellow)	7 (3.5)
	Trainee (Resident)	23 (11.5)
	Advanced Practice Provider (APP)	17 (8.5)
Specialty	Vascular Neurology	75 (37.5)
	Neurocritical Care	56 (28)
	General Neurology or Neurohospitalist	27 (13.5)
	Interventional Neuroradiology	5 (2.5)
	Emergency Medicine	24 (12)
	Neurosurgery	3 (1.5)
	Other*	10 (5)
	Practice region	Northeast
Midwest		65 (32.5)
South		68 (34)
West		38 (19)
Stroke capabilities	Comprehensive Stroke Center Certification	165 (82.5)
	Thrombectomy-Capable Stroke Center Certification	15 (7.5)
	Primary Stroke Center Certification	15 (7.5)
	Acute Stroke Ready Hospital Certification	1 (0.5)
	Other**	4 (2)

*Epileptologist and vascular neurology, vascular neurology and neurocritical Care, headache, neuroradiology, epileptologist,

**Both comprehensive and primary stroke center certification, outpatient only, telemedicine only

(82.5%) identified themselves as working in the setting of a comprehensive stroke center (Table 2). Survey respondents represented 39 states.

Descriptive data: hospital transport practices

Respondents reported the following: no change in hospital transport practices in 95 (47.5%), transferring most patients in 53 (26.5%), transferring only some patients in 20 (10%), and significantly limiting the number of patients transferring in 14 (7%). Other responses included “We went on Neuro-divert” and “Yes, EMS stopped bringing us patients altogether”. Most responded that mechanical thrombectomy (MT) (96.5%), ruptured aneurysm (88.5%), ICH intervention (86%), and hemicraniectomy monitoring (81.5%) warranted transport to a higher level of care.

Table 3. Change in stroke alert practices

Response	N (%)
Yes, we now use surgical masks/PPE for select patients	49 (24.5)
Yes, we now use surgical masks/PPE for ALL patients	127 (63.5)
Yes, we utilize telestroke/telemedicine more frequently	100 (50)
Yes, we rely on primary team evaluation and perform EMR and imaging review	31 (15.5)
Yes, we utilize telephonic consultation more frequently	49 (24.5)
Yes, we limit number of practitioners in the room	129 (64.5)
No change in practice	14 (7)
Other*	10 (5)

*Ensuring bed assignment prior to transfer, virtual rounding

Descriptive data: stroke alert practices

Participants from many institutions reported implementation of new policies regarding acute stroke management to limit healthcare provider exposure, and these practices varied widely (Table 3). Common strategies to ensure patient and provider safety included using personal protective equipment (PPE) during evaluation of all patients (63.5%) and limiting the number of practitioners in the room (64.5%). Despite increased precautions, most respondents (89.5%) did not report change in eligibility criteria for interventional therapies such as IV-tPA or MT. Other responses included elective intubation for MT patients to “reduce exposure in the angiography suite”, and more conservative criteria for MT with regards to age and baseline Modified Rankin Scale.

Descriptive data: step-down and neurocritical care unit practices

Many (23.5%) respondents stated policy change in admission of post IV-tPA and post MT patients to step-down units. Several centers approved reduced monitoring of vital signs/neuro checks for only 12 hours instead of the typical 24 hours done routinely for post IV-tPA care. Other responses included rapid COVID-19 testing prior to admission and conversion of step-down beds to ICU beds.

In addition, there were several reported changes in the patient care model of Neuro Intensive Care Units. Many Neuro ICUs are caring for person’s under investigation (PUI) (39%) or COVID-19+ (33.5%) patients, or are being used to offload other ICUs such as the MICU (34%). Many hospitals combined specialty ICUs with all COVID-19 + patients or PUIs in one geographical unit or on a single floor of the hospital. Other written comments reported

that some ICUs within the hospital, including dedicated Neuro ICUs, had been converted to COVID-19 only units.

Main results: subjective outcomes

Most respondents (81%) reported a decrease in stroke volume. Only 2.5% of respondents reported increase in total volume of stroke patients and 14% reported no change. Several individual comments suggested: "More large vessel occlusions, less number of minor strokes or stroke suspects. The number of conversion disorder [and] stroke mimics were also reduced." Many (34%) respondents felt that the outcome or care of stroke patients had been impacted by the COVID-19 pandemic. Other responses included delay in presentation limiting eligibility for interventional therapies, limited access to transesophageal echocardiogram, difficulty with disposition to rehabilitation, and "unsure" or "too early to say."

Main results: statistical analysis

Demographic variables were compared to perceived change in outcome or care of stroke patients and perceived change in stroke volume. There was no association with baseline characteristics and perceived change in outcome or care of stroke patients: role ($p=0.963$), specialty ($p=0.546$), region ($p=0.960$), and stroke center capabilities ($p=0.379$). Interestingly there were differences regarding change in stroke volume for role ($p=0.021$), area of specialty ($p<0.001$) and region (0.016), but not stroke center capabilities ($p=0.701$). Attending physicians, neurovascular and neurocritical care respondents, and practice region in the South or Midwest were more likely to report differences.

A binomial logistic regression was performed to ascertain the effects of change in stroke practice on the likelihood of a perceived change in outcome or care. 16 cases were excluded given "other" response to this question. No outliers were found. The logistic regression model was statistically significant $\chi^2(4) = 10.261$, $p=0.036$. Of the four predictor variables, two were statistically significant and one showed a trend towards significance (Table 4). Notably, change in hospital transport guidelines

(OR 1.325, $P=0.047$, 95% CI: 1.004-1.748), change in eligibility criteria for IV-tPA or MT (OR 3.146, $P=0.052$, 95% CI: 0.988-10.017), and admission practices for post IV-tPA or MT patients (OR 2.141, $P=0.023$, 95% CI: 1.110-4.132) were associated with a perceived change in the outcome or care of stroke patients during COVID-19.

Discussion

The COVID-19 pandemic has multifactorial impact on the logistics of stroke care and has required rapid adaptation at stroke centers nationally. Special considerations include: maximizing safety of healthcare workers and patients (appropriate PPE and adjustment in protocols to include enhanced screening of patients for COVID-19), effect of mitigation policies on stroke volumes, and changes in protocols that would potentially add delays to time sensitive acute treatments.

Key results

Our study demonstrated the rapidly changing environment surrounding stroke patients in the era of COVID-19. Stroke volumes were reported to be decreased. Many respondents also felt that the outcome or care of stroke patients at his or her institution had been impacted by the COVID-19 pandemic.

Interpretation

Based on our multicenter survey, it can be gleaned that across the country a majority of centers are seeing lower stroke volumes compared to pre-pandemic numbers. Several centers noted that, despite the lower overall volumes, large vessel occlusion and major strokes have been on the rise. Our findings are in alignment with several other reports.³⁻⁵

One hypothesis for this phenomenon is patients' fearing or avoiding the emergency department due to the risk of COVID-19 infection.⁴ Patients with treatable minor stroke syndromes may be waiting too long at home, precluding acute management and risking the possibility of progression to severe neurologic injury. Furthermore, strategies for mitigating COVID-19 spread in the community have decreased inpatient stroke volumes observed nationwide.

Table 4. Factors associated with a perceived change in the outcome or care of stroke patients during COVID-19

Variable	OR (95% CI)	P
Did your institutional guidelines for hospital transport change during the COVID-19 pandemic?	1.325 (1.004-1.748)	0.047
Is there any change in eligibility criteria for tPA or thrombectomy to limit staff exposure and save resources for PUI or +COVID-19 patients?	3.146 (0.988-10.017)	0.052
Have you changed admission practices for post-tPA or thrombectomy patients due to the COVID-19 pandemic?	2.141 (1.110-4.132)	0.023
Has your Stroke and/or Neuro Intensive Care Unit been affected by the COVID-19?	1.068 (0.706-1.617)	0.754

Responses included "yes", "no" or "other"

Analysis of CT RAPID software counts of 231,753 patients in 856 U.S. hospitals showed 39% decrease in acute stroke evaluation in March compared to February 2020.⁶ Other countries have observed collateral effects of the pandemic due to policies to mitigate spread of COVID-19 in the community, which have led to delays in care for urgent conditions such as myocardial infarction.⁷ Another study reported a delay in acute stroke from 4.5 h pre-outbreak to 9.8 h in March 2020.⁸ Once triaged, additional COVID-19 screening, enhancements in PPE protocols, and added considerations for safe practice during anesthesia for endovascular therapy may further prolong time to acute intervention. Several other studies reported these diverse changes in stroke systems of care.^{9–12}

In response, AHA published Protected Code Stroke guidelines and Temporary Emergency stroke guidelines.¹⁰ There are also proposed updated algorithms for MT in the COVID-19 era.¹³ The Society of Vascular and Interventional Neurology on MT has also published a guideline state on MT during COVID-19.¹⁴ The Society for Neuroscience in Anesthesiology and Critical Care (SNACC) has published a statement on anesthesia recommendations for MT.¹⁵ A consensus recommendation by multiple academic stroke centers has been published on preserving stroke care during COVID-19 pandemic.¹⁶

Additionally, an argument can be made for proactive public education regarding the feasibility of safe delivery of acute stroke care despite the ongoing pandemic.⁷ Although the COVID-19 pandemic has redirected the healthcare focus and resources as a public health emergency, stroke continues to be a cause of neurologically devastating injury and remains an important cause of morbidity and mortality across the USA. Hence continued efforts to ensure delivery of effective and evidenced based stroke care is critical.

Ultimately, nationwide procedural changes have been implemented to ensure the safety of patients, healthcare providers and hospital staff to allow for continued effective care throughout this pandemic. These necessary efforts can be streamlined in ways to decrease a delay in emergent care, as in the case of acute stroke patients. Suggestions to consider include: expanding the availability and expediting the result processing of Rapid RT-PCR SARS-CoV-2 testing both in the emergency department and from transferring hospitals to allow for efficient triaging; dedicating a single CT Scanner and/or Angiogram Suite to limit cross contamination of patient's and streamline the turnover process; and/or intubating all patients requiring MT if COVID-19 status is pending to ensure safety of providers without delaying door to groin puncture times.

Limitations

Survey responses limit our data to subjective interpretations of stroke care at individual institutions. Stroke quality metrics and objective outcomes were not incorporated

into this study. While we did have survey respondents from almost every state in the USA, many have only 1-3 respondents, and several states appeared oversampled (California, Michigan, Ohio) which may limit external validity. Sample size was also not prioritized because of the rapidly escalating disease burden within the United States and the need to report our results in a timely fashion. A majority of respondents were from comprehensive stroke centers, which may also limit application to primary stroke centers and community-based hospitals.

The significance seen with change in stroke volumes dependent on area of speciality may potentially be confounded by the level of training and/or differing exposure rates to acute stroke care. Similar significance seen in regards to region may reflect regional practices, though small sample size limits utility of this finding. Prior studies suggested differences in patterns of care and hospital characteristics based on location.¹⁷

Conclusion

It is evident from our questionnaire that change in practices for acute stroke care including hospital transport guidelines and policies regarding interventional therapies may impact perceived stroke outcome or care. As emphasized in the AHA guidelines, hospital systems should make efforts to limit changes in established stroke practices. This is a pressing concern as current national and state wide restrictions may not lift for some time.

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Conflicts of Interest

None of the authors reports any conflict of interest.

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