STREAMLINED POSTSTROKE TREATMENT ORDER SETS DURING THE SARS-COV-2 PANDEMIC
Simplifying While Not Compromising Care

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BACKGROUND AND PURPOSE: Standard poststroke treatment monitoring protocols are made problematic during the coronavirus disease 2019 (COVID-19) pandemic by the frequency of patient assessments, requiring repeated donning and doffing procedures in a short interval of time.

METHODS: A streamlined poststroke treatment protocol was developed to limit frequency of patient encounters while maximizing the yield of each encounter by grouping together different components of poststroke care into single bedside visits.

RESULTS: Streamlined order sets were developed late March 2020. During the first 6 weeks following implementation, 70 patients were admitted to a geographically defined designated warm COVID-19 unit with modified poststroke care order sets. Of these, 33 (47.1%) patients received acute reperfusion therapy. All but 3 patients evolved favorably with either stable or improving National Institutes of Health Stroke Scale at 24 hours. In the 3 patients who experienced early neurological deterioration, none were found to be attributable to insufficient patient monitoring.

CONCLUSIONS: Adapting preexisting poststroke care protocols may be necessary while the risk of COVID-19 infection remains high. We propose a streamlined approach to facilitate poststroke monitoring in patients with stroke with unknown COVID status.
procedures where the risk of symptomatic post-thrombolysis intracranial hemorrhage is highest. A recent small single-center single-arm study found that low-intensity monitoring following intravenous thrombolysis was safe. Furthermore, the yield of each patient encounter was maximized by grouping together different components of poststroke care into single bedside visits (Table 1).

Streamlined order sets were used in patients admitted to a temporary stroke unit equivalent (a repurposed portion of the intensive care unit) while awaiting COVID-19 testing results to cohort warm patients and avoid contaminating staff from the main stroke unit. Information sessions and available support were available for nursing staff in these units by the interdisciplinary stroke team. COVID-19 testing was performed upon admission by nasopharyngeal swab in all patients, with results available within 24 hours after testing. Patients ultimately found to be COVID-negative were then transferred to the main stroke unit while patients with COVID-positive were transferred to a hot COVID unit.

Poststroke imaging and workup, including repeat brain scan at 24 hours, was delayed until COVID status confirmation to mitigate risk of viral spread during patient transport to CT scan. However, in the event of neurological deterioration in patients with pending COVID status results, it was recommended to proceed with imaging without delay but with utilization of all appropriate precautions.

Retrospective chart review for this study with waiver of consent was approved by our local institutional ethics committee.

RESULTS

Streamlined order sets were developed late March 2020, and were available for use as of April 1, 2020. During the first 6 weeks following implementation, 95 patients were evaluated for suspected acute stroke at our institution. Of these, 33 (34.7%) patients received acute reperfusion therapy, and 70 patients with a diagnosis of neurovascular pathology were admitted to the warm COVID-19 stroke unit (patient characteristics are listed in Table 2).

All but 3 patients evolved favorably with either stable or improving National Institutes of Health Stroke Scale Score at 24 hours. Of the 3 patients who experienced early neurological deterioration, 2 were patients with intracranial hemorrhage associated with anticoagulation use (multifocal intracranial hemorrhage on enoxaparin; and traumatic subdural hematoma on apixaban in a non-surgical candidate) experienced hematoma expansion despite aggressive blood pressure management and anticoagulation reversal. The third patient experienced immediate deterioration postendovascular thrombectomy due to recurrent ipsilateral embolism to the M1 segment of the middle cerebral artery. The deterioration occurred while still in the angiography suite and before transfer to the warm unit and subsequently underwent a second mechanical thrombectomy. No deterioration was deemed attributable to insufficient monitoring from the lower-frequency, streamlined stroke order sets.

Two of the 95 patients evaluated for suspected stroke tested positive for COVID-19. These 2 patients were, however, diagnosed with a stroke mimic and admitted to a COVID-19 warm unit other than the one assigned to stroke.

CONCLUSIONS

Modifications to preexisting poststroke care protocols may be necessary during the COVID-19 pandemic to balance adequate patient safety while mitigating risk of infectious exposure while the risk of COVID-19 infection remains high. We present a streamlined approach to facilitate poststroke monitoring in patients with stroke with unknown COVID status.

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Second mechanical thrombectomy. No deterioration was deemed attributable to insufficient monitoring from the lower-frequency, streamlined stroke order sets.

Two of the 95 patients evaluated for suspected stroke tested positive for COVID-19. These 2 patients were, however, diagnosed with a stroke mimic and admitted to a COVID-19 warm unit other than the one assigned to stroke.

CONCLUSIONS

Modifications to preexisting poststroke care protocols may be necessary during the COVID-19 pandemic to balance adequate patient safety while mitigating risk of infectious exposure while the risk of COVID-19 infection remains high. We present a streamlined approach to facilitate poststroke monitoring in patients with stroke with unknown COVID status.
Table 1. Original and Streamlined Poststroke Treatment Protocol

| Original Standardized Stroke Order Set Following Thrombolytic and EVT Treatment | Proposed Streamlined Modifications |
|---|---|
| Vital sign and neurological assessment | Vital sign and neurological assessment |
| Continuous cardiac monitoring via telemetry | Continuous cardiac monitoring via telemetry |
| Continuous pulse oximetry | Continuous pulse oximetry |
| Vital sign assessment | Vital sign assessment |
| q 15 min for first 60 min | q 15 min for first 90 min (Emergency Department or in angio suite per-EVT)* |
| q 30 min for 2 h | q 30 min for the first hour postprocedure and upon arrival to stroke unit or equivalent (if patient is isolated for suspected COVID—then nurse to remain with patient to avoid donning/doffing when permitted) |
| q 1 h × 16 h | q 1 h × 4 h |
| | q 2 h × 12 h |
| | *Preprogrammed and automated vitals measures to be preferred where possible |
| | *It is imperative to treat high BP post-thrombolysis and EVT as per established protocols |
| | *A bedside kit with medication at the nursing staff’s disposal may help minimize contamination and facilitate administration* |
| Neurological assessment | Neurological assessment |
| q 15 min for first 60 min | q 30 min for first 90 min (Emergency Department, before EVT and following EVT) |
| q 30 min for 2 h | q 30 min×2 postprocedure upon arrival to stroke unit or equivalent (if patient is isolated for suspected COVID – then nurse to remain with patient to avoid donning/doffing when permitted) |
| q 1 h × 4 h | q 4 h × 12 h |
| q 2 h × 8 h | q 6 h |
| q 4 h | |
| Temperature | Temperature (to be performed during same session as neuro signs) |
| q4h | Once at patient arrival to ED |
| | Once at arrival at stroke unit or equivalent |
| | q 4 h × 12 h |
| | q 6 h thereafter |
| Femoral arterial puncture site (EVT cases) | (to be performed during same session as neuro signs) |
| Neurovascular vital signs at same frequency as vital sign and neurological assessment | q 30 min×2 in the first hour postprocedure upon arrival to stroke unit or equivalent |
| | q 4 h × 12 h |
| Blood sugar levels | (to be performed during same session as neuro signs) |
| q8h | first measure in ED |
| | at patient arrival at to stroke unit or equivalent |
| | q 4 h × 12 h |
| | q 6 h thereafter |
| Dysphagia screen | NPO until dysphagia screen using validated test within first 4 h following stroke |
| NPO until dysphagia screen using validated test within first 4 h following stroke | If known COVID-19 positive: wait for formal speech therapy assessment |
| Voiding | Postvoid bladder scan q 8 h |
| | Suprapubic palpation to evaluate for distended bladder q4h |
| | If no voiding or distended bladder: insert Foley catheter |
| | Reassess once COVID negative status confirmed |
| Medication administration | Administered as ordered once swallowing status known |
| | Opt for once daily administration of medication where possible |
| | Group PO medication (if swallowing status cleared) where possible |
| Thromboprophylactic therapy | Administered as ordered |
| | Opt for once daily administration where possible (enoxaparin 40 mg s/c q 24 h) |
| | Other options: sequential intermittent compression stockings, or unfractionated heparin in patients with creatinine clearance (<30 mL/min) |

BP indicates blood pressure; COVID-19, coronavirus disease 2019; ED, Emergency Department; EVT, endovascular thrombectomy; LWMH, low molecular weight heparin; NPO, nil per os; and PO, per os.

*Point of high importance.
Table 2. Patient Characteristics of Patients Admitted to Warm COVID-19 Stroke Units

|                                | n=70 |          |
|--------------------------------|------|----------|
| Age, y, mean±SD                | 69.8±16.5 |          |
| Sex (n, % male)                | 38 (54) |          |
| Baseline modified Rankin Scale, median (IQR) | 1 (0–1) |          |
| Baseline comorbidities, n (%)  |      |          |
| Hypertension                   | 41 (59) |          |
| Dyslipidemia                   | 32 (46) |          |
| Diabetes mellitus              | 18 (26) |          |
| Atrial fibrillation or flutter | 14 (20) |          |
| Prior ischemic stroke or TIA   | 20 (29) |          |
| Antiplatelet use               | 19 (27) |          |
| Oral anticoagulant             | 18 (26) |          |
| Final diagnosis, n (%)         |      |          |
| Transient ischemic attack      | 1 (1)  |          |
| Ischemic stroke                | 55 (79) |          |
| Non-LVO stroke                 | 29 (41) |          |
| LVO stroke                     | 26 (37) |          |
| Intracranial hemorrhage        | 10 (14) |          |
| Stroke mimic*                  | 4 (6)  |          |
| Acute stroke treatments, n (%) |      |          |
| Intravenous thrombolysis       | 8 (11)  |          |
| EVT                            | 9 (13)  |          |
| Both thrombolysis and EVT      | 16 (23) |          |
| Initial NIHSS score, median (IQR) | 12 (4–19) |          |
| 24-hour NIHSS score, median (IQR) | 6 (2–13) |          |

COVID-19 indicates coronavirus disease 2019; EVT, endovascular thrombectomy; IQR, interquartile range; LVO, large vessel occlusion; NIHSS, National Institutes of Health Stroke Scale; and TIA, transient ischemic attack.

*Patients who were admitted with initial diagnosis of ischemic stroke but with final diagnosis of stroke mimic.