

## BRIEF REPORT

# 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.

Standard poststroke treatment procedures require enhanced patient monitoring, particularly within the first hours following intravenous thrombolysis and endovascular thrombectomy. These procedures are often based on protocols used in the pivotal National Institute of Neurological Disorders and Stroke thrombolysis trial, although many elements in such order sets have never been studied in detail.<sup>1</sup> In the context of the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) pandemic, poststroke monitoring is made problematic by the frequency of patient assessments, requiring repeated donning and doffing procedures in a short interval of time. Recent stroke guidance papers recommend adherence to published guidelines regarding acute stroke therapy and postrecanalization monitoring but acknowledge that full compliance may be limited in regions as the pandemic evolves.<sup>2,3</sup>

## METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request. The Centre Hospitalier de l'Université de Montréal is a high-volume comprehensive stroke center in Montreal, Quebec, Canada, performing >300 thrombolysis and endovascular thrombectomy procedures annually. As of late March 2020, the city of Montreal became, and remains, the epicenter of the Canadian SARS-CoV-2 pandemic. Based on recommendations of the institutional infectious disease prevention and control team, patient encounters in patients with suspected or positive coronavirus disease 2019 (COVID-19) were to be minimized to a maximum of 4 patient encounters per 24 hours.

Accordingly, in collaboration with stroke neurology and nursing staff, streamlined poststroke order sets were developed to minimize patient encounters while attempting to ensure adequate patient surveillance, particularly in the hours following reperfusion

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## Nonstandard Abbreviations and Acronyms

<b>COVID-19</b>	coronavirus disease 2019
<b>SARS-CoV-2</b>	severe acute respiratory syndrome coronavirus-2

procedures where the risk of symptomatic post-thrombolysis intracranial hemorrhage is highest.<sup>4</sup> A recent small single-center single-arm study found that low-intensity monitoring following intravenous thrombolysis was safe.<sup>5</sup> 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 patients with 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.

## ARTICLE INFORMATION

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**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	
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	
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	
q4h	Temperature (to be performed during same session as neuro signs)
	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)	
Neurovascular vital signs at same frequency as vital sign and neurological assessment	(to be performed during same session as neuro signs)
	q 30 min×2 in the first hour postprocedure upon arrival to stroke unit or equivalent
	q 4 h × 12 h
Blood sugar levels	
q6h	(to be performed during same session as neuro signs)
	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)
Options: sequential intermittent compression stockings, or LWMH (ie, enoxaparin 40 mg s/c q 24 h) or unfractionated heparin (5000 units s/c q 12 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.



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