

Neurointervention for emergent large vessel occlusion during the COVID-19 pandemic

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BACKGROUND

Introduced into the human population in December 2019, the zoonotic novel β -coronavirus spread rapidly. Labeled Coronavirus Disease 2019 (COVID-19) by the World Health Organization (WHO), the infection reached pandemic proportions by March 11, 2020. At the time of writing this commentary, globally our way of life is transforming. Hospitals are no exception, with mobilization into an emergency mode including halting all non-urgent elective procedures and clinic visits.

The Centers for Disease Control and Prevention (CDC) and the WHO are currently recommending aggressive measures to prevent viral transmission. For healthcare workers, aside from standard precautions like using personal protective equipment (PPE) and handwashing, these bodies are strongly encouraging the practice of 'social distancing' (SD) and 'self-quarantine' (SQ) for those with suspected or proven infections. In essence, SD means avoiding crowds, closing schools, canceling all social events and meetings, and maintaining a 6-foot distance between individuals. SQ refers to isolating oneself for 2 weeks without any social contact to

avoid transmission. These efforts will be critical to mitigating COVID-19 spread, as they may 'flatten the curve' of new and serious cases and prevent the healthcare system from being overwhelmed.

Healthcare workers are on the front line, and doctors, nurses, and hospital staff are at highest risk of contracting the virus. As cases become ubiquitous throughout the healthcare system, many staff will become secondarily infected and will require medical treatment and SQ. As the volume of infected personnel increases, many services will need to operate on a skeleton crew. If infection breaches a critical threshold, some emergency services may cease to be possible. The greatest potential impact will be on mechanical thrombectomy (MT) in acute ischemic stroke.

COVID-19 IN ACUTE ISCHEMIC STROKE

MT for emergent large vessel occlusion (ELVO) represents one of the most impactful and effective emergent interventions in medicine,¹ markedly reducing morbidity and mortality. MT is now one of the most common neurointerventional (NI) procedures, with treatment rates for ELVO increasing dramatically over the past few years, now with an incidence more frequent than every other day at many centers.² A survey of NI physicians from last year found 50% of physicians are on MT call every day or every other day.³ Additionally, in a recent survey of NI nurses and radiology technologists from 20 stroke centers in the USA, only nine of the 20 centers (45%) had more than six nurses or technologists in their call pools for stroke.⁴ Redeployment across the health and social care sector is an unfolding strategy aimed at directing the healthcare workforce to intensive care units to care for the growing number of COVID-19 patients. This trend suggests many hospitals are already at reduced capacity and may potentially decimate NI capability.

COVID-19 causes the most severe illness in the elderly, the immunocompromised, and those with other significant comorbidities.⁵⁻⁷ Most patients presenting with acute ischemic stroke fall into one or more of these vulnerable categories. Concomitant community or hospital-acquired COVID-19 among already tenuous stroke patients may represent an insurmountable barrier to meaningful recovery. ELVO patients may require lengthy hospital stays and consume increasingly scarce resources including ventilators and intensive care unit (ICU) beds, thereby competing with COVID-19 patients. It is in the best interest of every patient, physician, hospital system, and global healthcare system that we treat ELVO patients in a manner that maximizes their potential for a good outcome, reduces their inpatient length of stay, and minimizes their consumption of hospital resources.

Since MT has been shown to improve outcomes and reduce mortality in ELVO patients, it follows that a successful thrombectomy reduces length of stay, ICU days, and improves discharge dispositions.⁸ For these reasons, in most cases, an aggressive approach to MT in patients with ELVO is justified. A realistic, forthright, and prompt approach to establishing 'do not resuscitate' (DNR) status for patients, and discussing withdrawal of care for patients who fail to improve and demonstrate large infarct volumes on post-thrombectomy imaging, is appropriate. To maximize resources, it is imperative to establish these parameters at the time of the initial consent, prior to the intervention. This represents a paradigm shift in the standard treatment of ELVO patients.

While contraction of general hospital and NI services occurs, outreach to referring hospitals and providers must emphasize that the service remains immediately available for the most critical NI patients (eg, ELVO, subarachnoid hemorrhage, hemorrhage from head or neck lesions, or trauma). This may require seeking assurances from hospital leadership that a cohort of beds and other resources such as healthcare personnel will remain available to attend to such emergencies.

PRACTICAL APPROACH TO THE MANAGEMENT OF THE POTENTIAL COVID-19 PATIENT WITH ELVO

Rarely will patients be transferred with known COVID-19 disease status. In areas with advanced community infection, every transfer must be handled as a suspected COVID-19 case until this has been determined. In certain centers, selected

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scanners for COVID-19-positive or rule-out patients may be set aside to facilitate PPE utilization and cleaning procedures, with implications on workflow.

Protocols for PPE use, and post-imaging cleaning of scanners, should be clarified and practiced. Emergency room triage and imaging procedures should be evaluated for expediency, with the minimum number of staff involved in patient examination, transport, and scan acquisition. In general, PPE is required for all healthcare workers in contact with COVID-19-positive patients as well as those patients under investigation.

To minimize disruption on the treatment workflow, full PPE use should be recommended for healthcare workers. Patients should be treated as 'presumed positive' due to the emergency nature of large vessel occlusion, the degree of penetration of the COVID-19 virus within our community, and the varying (and often subclinical) presentation of illness.

A challenging component of procedural care during a respiratory pandemic is handling the anesthetic management when treating suspected or known COVID-19 patients. There are several advantages to general anesthesia in the setting of MT for acute stroke. Three recent studies have provided evidence that protocolized general anesthesia (GA) by experienced anesthesiologists improves patient outcomes. In the SIESTA study, favorable outcomes were significantly better in GA patients (37.0%) than in conscious sedation (CS) patients (18.2%).⁹ Similarly, in the GOLIATH study, favorable neurological outcomes were significantly better with GA than with CS (OR 1.9, 95% CI 1.03 to 3.56) and reperfusion rates were higher with GA and patients had smaller growth of infarct volume after GA.¹⁰

An argument against GA during the COVID-19 pandemic is that intubation and extubation are highly aerosol-generating procedures and any disconnection of the circuit has the potential to further aerosolize secretions. Use of CS is thought to avoid this intense aerosolization. Santarpia *et al* at the University of Nebraska has shown that SARS-CoV-2 is shed during respiration, toileting, and fomite contact. Air samples from patients' rooms tested positive for SARS-CoV-2, and the highest airborne concentrations were recorded while a patient was receiving oxygen through a nasal cannula. These new and not yet peer-reviewed data support the concept that SARS-CoV-2 is airborne, potentially increasing the risk of performing a procedure under CS with or without a nasal cannula. Hypoxia,

however, can negatively affect outcomes on stroke patients undergoing NI. Current recommendations advise FiO₂ should be titrated to maintain SpO₂ >92% and PaO₂ >60 mm Hg (class IIa, level of evidence C)¹¹ and supplemental oxygen is universally applied to patients undergoing CS. If performed under CS, applying a mask or applying oxygen via a nasal cannula to a suspected COVID-19 patient needs to be avoided. As a result, oxygen saturations will typically fall below recommended values, worsening outcomes, and increasing the requirement to actively monitor and treat. Maneuvers to improve oxygenation, such as jaw thrust, increases the degree of airborne exposure to the anesthesia provider and other involved healthcare workers.

Since failure of CS and conversion to GA has been reported from 2.7% to more than 5%,¹² this could risk significant exposure of all in-room staff during emergent intubation performed under suboptimal (non-negative pressure) conditions. Considering the potential benefits of GA in the setting of MT for ELVO and the potential risks of airborne transmission of COVID-19 during CS, GA should be considered for MT cases. This consideration, however, is reliant on the accepted and best practices of individual hospitals as well as resources available (ventilators, critical care staff, nursing personnel, etc.) to manage these critically ill patients. Further experience with ELVO management under COVID-19 circumstances will guide future practice with respect to the need for GA.

According to current recommendations by the Anesthesia Patient Safety Foundation, patients with confirmed or suspected COVID-19 infections should not be brought to holding or post-acute care unit (PACU) areas preoperatively. Intubation and extubation should be accomplished in a negative pressure environment (for example, in an ICU room) and not the angiography suite. The minimum number of staff required for intubation should be in attendance, in full PPE. All participants in MT and other emergent NI case scenarios must be well-versed in the use of PPE and appropriate precautions. Staff should be reassured that such measures offer them adequate protection based on the limited available data.

OTHER CONSIDERATIONS FOR THE NEUROINTERVENTIONALIST

Family updates for cases should likely be conducted by telephone, as will consent procedures, and the need for witnessing may require creativity. Post-exposure staff

monitoring of symptoms is essential, with early reporting and testing if symptoms do develop. Additionally, if a suspected patient is tested, the results should be shared with those exposed, whether negative or positive. When positive, the need is clear, but nurses and technologists often do not get that follow-up for reassuringly negative results.

We may find ourselves taking call for weeks on end with limited assistance if partners or staff fall ill, or coordinating with other NI centers in the region to centralize care if staffing or capacity are increasingly challenged. Some of us may find ourselves covering the emergency rooms or ICUs due to extreme shortages, or performing the roles of nurses or technologists. This is far from 'business as usual', and we must all adapt quickly to best serve our patients and society.

CONCLUSIONS

In these most trying times, it is important that we remember why we became doctors in the first place: to care for those in need. We are presented with the opportunity to lead by example and encourage those around us to be safer and more resilient. The bonds of our NI community must remain strong and close, with communication and exchange of new information and innovations. We will get through this together.

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