Society of NeuroInterventional Surgery recommendations for the care of emergent neurointerventional patients in the setting of COVID-19.

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Introduction

The global pandemic of coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) represents an unprecedented challenge to our health care system.[1] As the number of identified COVID-19 patients exponentially increases, protocols for the safe delivery of care of both patients and providers are vital. This is especially true, given the number of healthcare providers that have contracted the disease. If we fail to protect physicians, nursing staff, and ancillary providers, we will fail to meet the needs of future patients. The successful care of future COVID-19 patients will depend on effective safety and prevention strategies for healthcare workers.[2]

Acute ischemic stroke (AIS) patients are a high-risk patient cohort. Li et al. performed an analysis of six studies encompassing 1527 patients with COVID-19, and demonstrated that patients with cardio/cerebrovascular disease comprised 16.4% of the cohort, but that the incidence was approximately three-fold higher among severe COVID-19 patients requiring intensive care (ICU) admission.[3] Thus, patients with a history of AIS and/or its risk factors are particularly at-risk for the severe form of COVID-19. Additionally, there is early evidence that SARS-CoV-2 can cause neurologic signs, and that it has been reported in the brains of both patients and animal models.[4] 36.4% of SARS-CoV-2 respiratory distress patients demonstrated neurologic symptoms, with 4.5% of severe patients suffering ischemic stroke.[5] In this setting, neurointerventionalists should expect to be involved in the care of COVID-19-positive patients, as well as those whose status is unknown and those at risk of a severe form of the disease.

While the data on COVID-19 are rapidly emerging, the Society of NeuroInterventional Surgery seeks to provide neurointerventionalists with rapid, up-to-date recommendations on the

management of stroke thrombectomy in this setting with an emphasis on safety measures for health care providers.

Criteria for Mechanical Thrombectomy

The presence of COVID-19 as a public health issue should not alter the inclusion and exclusion criteria for mechanical thrombectomy (MT). We recommend that providers use currently available guidelines and recommendations based on multiple randomized trials for identification and management of large vessel occlusion whenever possible.[6-8] Because of the significant proven benefit of thrombectomy for patients with ELVO, denial of this treatment likely creates a greater drain on healthcare resources.

Documented COVID-Negative Status

While it is relatively unlikely that most patients requiring MT will have a documented negative COVID-19 test, such a result within 48 hours prior to thrombectomy would indicate a 'COVID-negative' patient. In such cases, we recommend taking standard personal protective equipment (PPE) precautions (surgical cap, eye protection, gown/gloves, shoe covers, and proper donning/doffing hygiene) set forth by a provider's institution. False negative patients have been reported, and in regions of peak epidemic activity, protecting the healthcare team will need to be balanced with preserving PPE resources.

Documented COVID-Positive Status

Patients with COVID-positive documentation (or those presumed positive; see below) should be treated with maximum safety precautions. Intubation, extubation, suction, and active CPR may result in aerosolization of respiratory secretions, increasing the risk of exposure to personnel. Intubated patients pose less of a transmission risk to neurointerventional staff given that their ventilation is managed through a closed circuit. Nonetheless, disruption of the circuit (such as for

a cuff leak, suctioning, endotracheal tube manipulation) can release additional aerosolized secretions. Therefore, we recommend standard institutional protocols with a low threshold for intubation of stroke thrombectomy COVID-19 positive patients *prior to* transport to the angiography suite, ideally in a negative pressure environment. For instance, patients with dominant hemisphere occlusions, very high NIHSS or low GCS, or posterior circulation occlusions (as well as any patient with significant symptomatic respiratory difficulty) should be considered for prophylactic intubation as the risk of intraprocedural intubation is high.[9] Once an intubated patient is transported into the suite, all providers should wear enhanced PPE at all times provided resources are available. This includes surgical cap, eye protection (goggles and face shield, not just glass), full gown/gloves, shoe covers, and an N95 mask or Powered Air Purifying Respirator (PAPR). It is recommended that treating physicians and interventional radiology technicians working in the case wear boot-type shoe covers if available to minimize contamination. Ideally, providers should use new N95 masks or PAPR for each encounter with a COVID-positive patient. To preserve N95 masks (given the recognized shortage), it is reasonable to wear a standard surgical mask over the N95 mask for potential preservation, and to minimize the number of staff participating in the procedure. Providers should follow their institutional guidelines regarding use/re-use of N95 masks, given resource limitations. Patients should not be extubated in the angiography suite (unless in a negative airflow environment), but should be taken to an isolation intensive care unit room for planned extubation with airborne and contact precautions.

Undocumented COVID Status

Screening for fever and respiratory symptoms should be a part of the screening of all potential neurointerventional patients. Intubation of these patients prior to transportation to the

angiography suite should be considered, especially in patients with risk factors for intraprocedural intubation as noted above. Given that thrombectomy is such a time-sensitive procedure, that family members are often not available to provide a complete medical history, and that a neurologically impaired patient may not able to answer screening questions, it is recommended that unknown COVID-status patients be treated as high risk for COVID-positive (see above), provided institutional resources are available.

Additional Post-Thrombectomy Principles in the COVID-19 Setting

Some additional strategies after thrombectomy may be considered to assist in the care of patients, reduce risk to care providers, and maximize care of all patients in a setting of increased ICU utilization.

Early-Progressive Care And Related Protocols: Once COVID status is determined and the patient is extubated (if needed), it is recommended to transfer uncomplicated post-thrombectomy patients out of the ICU as soon as possible. Subsequent stroke etiology and prevention evaluation can be performed in other inpatient locations to maximize availability of ICU beds. It is recommended that institutions develop aggressive, yet safe, protocols to recover appropriate thrombectomy patients in non-ICU settings (Progressive Care/Step Down). It may be possible that there will be no available ICU beds in regions of high COVID-19 prevalence, and having the ability to recover thrombectomy patients in a non-ICU setting will be critical.

COVID Testing: Given that stroke patients may not be able to provide a full history due to neurological impairment, it is recommended that, should resources be available, all AIS post-thrombectomy patients undergo COVID-19 testing if available during their admission. This will allow preservation of valuable PPE, and separate true COVID-19 positive populations to prevent

nosocomial transmission. However, given the limited availability of COVID-19 testing, state and local public health guidance may vary regarding who to test, and when.

Angiography equipment and turnover: Since a majority of MT patients will be COVID-positive or presumed positive in the current environment, effective cleaning of angiography equipment and suites will have an impact on turnover times and readiness for additional cases. For this reason, it is recommended that elective and non-urgent cerebrovascular cases be postponed until the pandemic's peak has been reduced. It is also recommended that for hospitals with multiple angiography suites, one suite is designated as a "COVID room" and stocked for treatment with enhanced PPE and accessible interventional equipment to minimize intraprocedural staffing. The establishment of negative-pressure (rather than positive-pressure) ventilation in angiography suites is worth consideration.

Staffing organization and PPE use: Shift-based allocation of staff and physicians to separate individuals with overlapping skillsets is recommended. All neurointerventional personnel should be fit-tested for N95 masks, and be well versed in the proper techniques for doffing and donning PPE, including eye protection.

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