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Roadmap for Resuming Elective Neuroendovascular Procedures Following the First COVID-19 Surge

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Introduction

During the surge, health care resources were reallocated to prioritize the care of critically ill COVID-19 patients. Anticipated potential limitations in health care resources (personal protective equipment (PPE), ventilators, personnel, hospital space) resulted in triaged delays of non-emergent endovascular procedures and surgeries.^{1–3} Triaged delays carry risk, since postponing elective surgeries can lead to deteriorating patient conditions, or exposure to an unfavorable natural history event; either of which may result in irreversible injury, increased health care cost, and reduced quality of life.³

As we emerge from the initial peak of the COVID-19 pandemic, we recognize the intent to resume elective neurointerventional procedures. This resumption is necessary in order to optimize patient care, while recognizing the continuing need to contain and minimize transmission of infection. On one hand, increasing the number of elective surgeries will potentially expose larger number of patients and healthcare providers to COVID-19, placing older patients or subjects with chronic conditions at risk for infection and subsequently a higher fatality rate.⁴ On the other hand, delaying urgent care such as the treatment of large unruptured, symptomatic or basilar aneurysms can

place the patient at risk for a life-threatening event such as aneurysm rupture or intracranial hemorrhage. We discuss several aspects of care that should be considered during the neuroendovascular resumption of an elective phase including hospital bed capacity, PPE resources, pre-procedure testing and post-procedure care.

Timing for transitioning to urgent, semi-urgent and elective procedures

Resuming elective procedures should be considered when there is a sustained reduction in new COVID-19 cases or sustained reduction in COVID-19 related deaths for at least two weeks (i.e., one incubation period) in the relevant geographic area.² A hospital should also have transitioned well out of the phase of crisis standard of care. Any resumption of such non-emergent service activity should be authorized by the appropriate local, regional and state health authorities (department of public health) and monitor trends in the number of regional cases and deaths to adjust case volume accordingly.

Hospital capacity and PPE resources

In concert with local public health authorities and health system administration, discussion of standard hospital preparations and timelines for elective service resumption should consider hospital bed capacity, in order to accommodate for the ongoing admission and provision of care of COVID-19 patients.

Hospitals should ensure that sufficient regional ICU and non-ICU bed capacity, PPE, medical and surgical supplies and COVID-19 testing capacity, as well as staff, are available before transitioning to reopening the first phase of healthcare activity. The Human Health Services of Massachusetts and New York recommend, for example, greater than 30% availability for staffed adult ICU beds and > 30% staffed adult inpatient beds. Facilities should ensure sufficient availability of COVID-19 testing and facilitate testing policies to provide useful preoperative information to both patients and staff.^{5,6}

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Received June 29, 2020; revision received July 8, 2020; accepted July 16, 2020.

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1052-3057/\$ - see front matter

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<https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105177>

Strict PPE policies should continue to be implemented through the initial phases of re-entry, with policies and operations taking into consideration the availability and adequacy of PPE, training for proper use, re-use and conservation of PPE, and the maintenance of supplies required for potential successive waves of COVID-19.

Pre-reentry preparations

While the re-introduction of neurointerventional elective procedures can expose an additional specific and related risk of infection and stress, advance preparation and the development of modified pre-procedure protocols, intra-procedural protocols (sharing similarities with acute neurological emergencies),^{7–9} and post-procedural protocols can help organize the care of the patient, optimize peri-procedural risk to both patient and health care provider, and accommodate for appropriate resource allocation.

A list of patients, their procedures, and a prioritized rank list with a timetable allows healthcare workers to prioritize these cases based on their lesion, expected natural history and acuity of disease.¹⁰ A prioritization policy committee can develop a strategy appropriate to optimize safety given patient needs, and can act to determine the order of medically necessary operations independent of hospital resource concerns, or COVID-19 associated risks.¹¹ Examples of neurointerventional procedures that should be prioritized include large, symptomatic, or irregular shaped aneurysms or those with prior sentinel episodes¹²; high-grade dural arteriovenous fistula with venous hemorrhage risk; recent vertebral fractures failing medical management and therefore considered for vertebroplasty¹³; diagnostic angiograms especially with a suspected underlying vascular lesion (such as a high flow arteriovenous fistula or malformation, or a suspected aneurysm seen on cross-sectional imaging); initial follow-up angiograms for treated previously ruptured aneurysms; and spine interventions for back pain.

Across the peri-procedural phases of the patient's care, steps should be taken to shorten the duration of in-person patient contact whenever possible as long as risk COVID-19 contagion remains present. These phases include pre-procedure, procedural hospitalization, and post-procedure phases. Telehealth visits in the pre-procedure and post-procedure setting should be considered when possible to minimize the possibility of infection to the greatest practical extent. Patients should wear a surgical mask in the hospital or clinics throughout the phases of care.

Pre-procedure care

Well in advance of their planned procedure, the patient should be screened for symptoms and signs of COVID-19 infection. Symptoms such as cough, shortness of breath, fever, diarrhea, orthopnea, loss of smell and/or taste, should be reviewed with the patient. Once the procedure

is discussed with the patient and a date established, the patient should be asked to take all reasonable precautionary measures to avoid contracting COVID-19 pre-procedure from the community. These measures include rigorous hand hygiene, meticulous physical distancing and wearing a mask when in a public or in both indoor and outdoor spaces two weeks preceding the procedure.

Where COVID-19 continues to be present, testing for COVID-19 should be undertaken 24–72 h prior to the planned procedure, and the test results must be available to the provider prior to the patient's entry into the hospital. If the test result is positive for COVID-19, strong consideration for rescheduling the patient should be undertaken, weighing the relative risk for delaying treatment against recent sobering data suggesting a high mortality and post-operative pulmonary complications in patients with peri-operative COVID-19 infection.¹⁴ If the patient's condition is urgent, i.e. symptomatic or large aneurysm, then discussion with the patient, infection control, and the patient's physician should be undertaken to consider benefits vs. risk of treatment in a COVID-19 positive patient. If following such a multidisciplinary discussion it is thought reasonable to proceed with the procedure, then the patient should also be counseled regarding the additive or multiplicative risks of COVID-19 related complications such as pneumonia, cytokine storm, fibrinolysis shutdown and intravascular thrombosis in the setting of a vascular procedure. Alternatively, a patient with a large aneurysm who tests positive for COVID-19 can be re-tested in 2-3 weeks and rescheduled for their procedure when they test negative.

Even with these aforementioned considerations, elective surgery may still pose a greater risk of infection to the patient. This increased risk is especially the case with COVID-19 positive patients, who demonstrate a higher mortality rate following elective surgery.² Intensive COVID-19 screening of patients considering elective surgery should be done to both reduce the number of test-positive high-risk patients, while also protecting COVID-19 negative patients. Diagnostic tests, such as RT-PCR, RDT, ELISA tests, can be used to confirm that patients are COVID-19 negative and eligible for elective surgery.² Post-surgical patients should likewise also be considered as suspect and considered for nucleic acid sequencing.

Intra-procedural care

For elective neurointerventions that require general anesthesia, even during the waning phases of the COVID-19 pandemic, it is advisable to consider intubating and extubating patients in a negative pressure room, wearing N-95 masks. This degree of caution is advisable even with patients who test negative for COVID-19, given the incidence of false negative test results. In case a COVID-19 positive patient's procedure was not performed in a negative pressure angiography suite, deep cleaning of the

neuroangiography procedure room should be performed and the room should remain locked down post-cleaning for 2 h.

Post-procedure care

Following the patient's procedure, the earliest reasonable discharge to home should be undertaken once the patient is deemed medically stable. In addition to routine hand hygiene and mask precautions, the patient should be instructed to continue to exert all reasonable precautions including physical distancing for fourteen days following the procedure, in the event that nosocomial asymptomatic contagion took place.

Virtual telehealth visits instead of in-person visits should continue whenever possible, in order to maintain continuity of care for following-up with the patient.

Conclusion

These aforementioned strategies reduce the total time of treatment, increasing capacity and potential resources, permitting the gradual elective reintroduction of neurointerventional procedures without overwhelming staff and hospital resources. It is possible to reintroduce neuroendovascular procedures, to simultaneously ensure the safety of both patients and provider teams, and to secure ongoing access to care for COVID-19 patients. Prospective planning, thoughtful organization, and an attention to detail are the essential prerequisites for success, and for optimizing the care of these vulnerable patients.

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