

Seven-point Checklist: Have You Prepared Sufficiently for the COVID-19 Crisis in Your Neurosurgery Department?

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Abstract

Coronavirus disease 2019 (COVID-19) is a novel infectious disease caused by severe acute respiratory syndrome coronavirus 2. COVID-19 was initially detected in Wuhan, China, in late 2019, and has now rapidly spread worldwide. Departments of Neurosurgery are required to employ an acute response against this pandemic. In this article, we discuss the important factors that neurosurgeons need to consider when managing their departments during the COVID-19 pandemic. We have summarized perspectives of the articles published on COVID-19, as well as the suggestions from neurosurgical societies in highly infected regions. We have proposed a seven-point checklist for neurosurgery departments: (1) networking among medical institutions; (2) coordinating teams within each institution; (3) prevention of infection within the department; (4) perioperative management; (5) triage; (6) changing subspecialty management protocols; and (7) psychological support for medical staff and patients.

Keywords: neurosurgery, COVID-19, system, policy, checklist

Introduction

Coronavirus disease 2019 (COVID-19) is a novel infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), initially detected in Wuhan, China, in late 2019, and has now rapidly spread worldwide. Globally, the implementation of early precautionary measures is anticipated to control the spread of COVID-19 through the restriction of activities. Hence, COVID-19 is not only an issue for doctors in departments of infectious disease but also a challenge for medical staff across all departments, including neurosurgeons. In some countries, such as China, Italy, Spain, and the United States, the pandemic occurred prior to other countries. Therefore, at the helm of these countries, the Department of Neurosurgery is required to employ an acute response against this pandemic.

Here, we discussed the important considerations regarding how neurosurgeons need to prepare for the COVID-19 pandemic taking into perspective the articles published on COVID-19, as well as the suggestions from medical societies associated with neurosurgery in highly endemic regions. We summarized these articles and suggestions as seven-point checklist (Fig. 1).

Seven Checkpoints for Neurosurgery Department during the COVID-19 Crisis

Check Point 1: Networking Among Medical Institutions

This COVID-19 crisis necessitates a change in the current medical system. To prevent the spread or exposure to SARS-CoV-2, it was suggested that elective surgeries were to be canceled or postponed for several months.¹⁾ This implied that medical resources, including beds, medications, ventilators, and medical staff, should be secured for patients with COVID-19. However, neurosurgeons encounter many emergency cases daily. Even during this crisis, emergency surgeries need to be performed to save patients. To manage this dilemma, we need to set up a network system to smoothly communicate with different institutions.

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Checklist for Institutions with Neurosurgical departments

1. **Networking among medical institutions**
 - Hub and Spoke system
 - Categorize by surge level of COVID-19
2. **Coordinating teams within each institution**
 - More than 2 independent teams
 - Backup team or alternate pool
 - Utilize teleconference
 - Consideration for staff over 60 years old
 - Consideration for pregnant staff
3. **Prevention of infection within the department**
 - Standardize PPE protocol depending on activities and settings
 - Standardize PPE protocol during operation depending on the patient's condition
 - Consider the use of reusable equipment
 - Zoning the areas leading to operation rooms
 - Anesthesia and intubation protocol
 - Consider management of outpatients using telemedicine
4. **Peri-operative management**
 - Protocol for perioperative screening test for COVID-19
 - Postoperative wards for neurosurgical patients maintaining a distance from COVID-19 wards
 - Consider management at non-ICU rather than ICU
 - Protocol for postoperative retesting and quarantine of patients
5. **Triage**
 - Triage table or protocol divided by urgency level and COVID-19 situation
6. **Changing subspecialty management protocols**
 - Stroke
 - Stroke network and health care system
 - Endovascular treatment
 - Protocol to select the type of anesthesia used
 - Prevention protocol for patients with unknown COVID-19 state
 - Monitor COVID-19 testing for patients using antithrombic medication
- Spine and peripheral nerve
 - Consider the advantages of improving ADL with intervention and risk of developing COVID-19
 - Consider minimally invasive techniques or approaches
 - Consider the prone position
 - Limit the use of electrotones
 - Cautious use of suction
 - Gentle operation
- Head trauma
 - If pan-scan CT is performed, check the chest CT
 - Prevention protocol for patients with unknown state of COVID-19
 - Pay attention to asymptomatic cases or symptoms masked owing to trauma
 - Recognize the lab findings of COVID-19 similar to posttraumatic fever
- Tumor
 - Try to avoid the transsphenoidal approach
 - Consider performing surgery with craniotomy
 - If the transsphenoidal approach is needed, make the patient wear a mask during surgery or ensure that the surgeon wears an air-purifying respirator
 - Consider adapting the temporal protocol of adjuvant therapy for glioma
 - Recognize lab findings of COVID-19 similar to the side-effects of temozolomide
- Pediatrics
 - Consider postponing neuroimaging with sedation
- Functional surgery
 - Confirm that the problems associated with the devices and battery depletion are not elective surgery
 - Consider the advantages of improving ADL with intervention and risk of developing COVID-19
7. **Psychological support for medical staff and patients**
 - Provide COVID-19 information and attempt to reduce patient's anxiety
 - Support system to guard the mental health of medical staff

Fig. 1 Checklist for institutions with neurosurgical departments. ADL: activities of daily living, CT: computed tomography, PPE: personal protective equipment.

This network system would help each institution determine and play a role in each local area or district. Burke et al.²⁾ introduced a system that categorizes medical institutions by surge levels of COVID-19. Community surge levels of COVID-19 were decided based on three factors: (1) the number of patients with COVID-19 in a community with medical institutions; (2) the number of inpatients with COVID-19 in the hospital, and (3) the number of medical staffing shortages. The least surge institution was labeled green and the worst surge was labeled black. In “black” institutions, all scheduled cases should be canceled, and only emergency cases are to be permitted to undergo operation. For each hospital, assessing the permitted surgery levels ahead of time could simplify stressful and difficult decision-making during this crisis. In “red” and “yellow” groups, surgery schedules should be reduced by 50% and 75%. Additionally, the number of outpatients needs to be reduced. This goal is to prevent infections between medical staff and patients. Moreover, another system was introduced

by Zoia et al.³⁾ In Italy, to maintain the function of rescuing emergency patients with neurological disorders, institutions were categorized into “hub” hospitals or “spoke” hospitals. Hub hospitals allowed the referral of emergency patients 24 hours a day and 7 days a week. Three hub hospitals cover Italy and divide Italy to the west, middle, and east. Any spoke hospital belongs to a hub hospital and can refer emergency patients to their hub hospital. To secure the neurosurgery staff, the staff is gathered in the hub to maintain their function for neurosurgical emergency cases.

Check Point 2: Coordinating Teams within Each Institution

To maintain neurosurgical practices, maintaining the number of neurosurgeons and teaming is crucial. We need to prepare a backup system for neurosurgeons who could be infected with COVID-19 and would need to self-quarantine for 2 weeks.

Reportedly, medical staff tend to get infected with COVID-19.⁴⁾ Burke et al.²⁾ introduced a pair-coverage

system. Each hospital has two independent neurosurgery teams, with each team member maintaining contact only within the respective team. Furthermore, as a means of contact, teleconferencing was recommended rather than face-to-face. An additional “alternate pool” group of neurosurgeons needs to be established. In situations where neurosurgeons are infected and need to self-quarantine, additional staff should be available to cover for the lack of neurosurgeons. Owing to this pair-coverage and alternate pool system, some neurosurgeons infected with COVID-19 do not cause dysfunctions in neurosurgical practice. However, these systems require a large amount of staff. Therefore, these systems could be beneficial when combined with a hub and spoke system.

Age is a known risk factor for COVID-19.⁵⁾ Hence, owing to a higher risk of developing COVID-19, we should consider excluding medical staff who are pregnant or over 60 years of age from work shifts.^{6,7)}

Check Point 3: Prevention of Infection at the Personal and Institutional Levels

It has been well established that personal protective equipment (PPE) is necessary for working medical staff. However, exposure risks are dependent on the situation and region. Therefore, we should utilize some level of PPE during different activities in various settings.⁸⁾ According to Hu et al.,⁹⁾ they adopted three levels of protection to avoid occupational exposure to the novel coronaviruses during surgery.⁹⁾ Level 1 patients confirmed as COVID-19 negative underwent surgery with normal PPE (with a surgical cap, surgical face mask, protective gown, and gloves). Level 3 patients, the highest risk patients, necessitate the use of a surgical cap, N95 face mask, goggles, face shield, full-facepiece respirator, protective gown, and gloves. Furthermore, the use of a reusable gown and face shield should be considered instead of disposable ones taking into account the equipment shortage.

In terms of the prevention policy of institutions, zoning areas are crucial. Rodrigues-Pinto et al.¹⁰⁾ suggested that the entry and exit into operation rooms should be categorized into five zones. This zoning helps prevent SARS-CoV-2 from entering the operating room from outside or spreading from surgical patients to outside of the operation rooms. The American Society of Pediatric Neurosurgeons proposed a system in the operating room.¹¹⁾ Intubation in the operation room should be performed with minimum staff present. Following intubation, entry into the operating room should be avoided for 30 minutes to reduce the risk of virus exposure, which might spread in the air during intubation.

For outpatient management, telemedicine has been recommended to reduce the risk of exposing patients to SARS-CoV-2.¹²⁾

Check Point 4: Perioperative Management

All surgical candidates in an epidemic area, as well as those undergoing procedures with a high risk of virus exposure, need to be screened for COVID-19. Additionally, in non-epidemic areas or procedures which do not carry a high risk, patients presenting a high risk for COVID-19, symptoms, or suspicion of COVID-19 should undergo preoperative screening. Hu et al.⁹⁾ recommended screening of COVID-19 for all preoperative patients. This would depend on the situation of the epidemic, healthcare systems, and government policy in each country or region. However, we recommend establishing a protocol regarding indications for preoperative COVID-19 screening, as well as postoperative re-testing or isolation.

In the case of wards housing postoperative patients who have undergone neurosurgical interventions, distance should be maintained from wards housing patients with COVID-19.⁶⁾ Postoperative patients who have undergone neurosurgery are vulnerable to COVID-19. Therefore, close attention should be paid to their postoperative management. Considering the limited medical resources, some postoperative patients could be observed in the non-intensive care unit (ICU) rather than in the ICU.¹²⁾ Hu et al.⁹⁾ recommended that all postoperative patients should be regarded as suspected COVID-19 cases, and should be quarantined for at least 2 weeks in areas with the epidemic. Moreover, it is crucial to limit the number of visitors when feasible.⁸⁾

Check Points 5 and 6: Triage and Changing Subspecialty Management Protocols

As mentioned in check point 1, emergency surgery should be performed following the appropriate protocol for the prevention of COVID-19. All surgical cases should be categorized in terms of emergency. Urgent categories have been suggested by relevant societies and associations. Some medical societies associated with subspecialties have recommended changing the management in pertaining fields. Here, we discussed two important highlights: urgency categorization and changing management, based on each subspecialty.

A. Stroke

Stroke is one of the most common diseases. However, medical practice function-related stroke has markedly decreased in China owing to the COVID-19 pandemic.¹³⁾ Additionally, the number of thrombectomies has reduced by 50% when compared with the last season. To maintain an option for rescuing stroke patients during this crisis, the

establishment of a stroke network and healthcare system has been strongly recommended.

As for subarachnoid and intracranial hemorrhages, many medical societies have suggested performing operations as under normal situations, but with sufficient prevention policies.¹⁴⁾

B. Endovascular treatment

In the field of stroke, acute ischemic stroke (AIS) is one of the most emergent conditions in neurosurgery. Mechanical thrombectomy and thrombolytic therapy have dramatically altered the treatment plan for stroke patients. Infarcted brain cells begin dying rapidly; therefore, prompt recanalization is crucial for a superior outcome.¹⁵⁾ During this crisis, endovascular treatment for AIS requires the most stressful decision-making. The Society for Neuroscience in Anesthesiology and Critical Care has suggested that general anesthesia should be extensively promoted more than before the occurrence of crisis to reduce the risk of a patient spreading the virus.¹⁶⁾ Additionally, a protocol for selecting the type of anesthesia has been proposed. For AIS, the COVID-19 screening test results should not be awaited. Therefore, almost all cases should be managed as suspected or unknown cases of COVID-19. Additionally, idiopathic epistaxis should be addressed when testing with pharyngeal swabs in patients with AIS due to antithrombotic drugs.¹⁶⁾

C. Spine and peripheral nerves

Surgical cases with cervical or thoracic myelopathy, acute spine trauma, oncological presentations, epidural abscess, cauda equina, or severe nerve root compression should be performed at hospitals as emergency cases. Acute or subacute lumbar disc herniations, cervical radiculopathy, acute hardware failure, or lumbar adjacent segment disease are considered urgent cases, and these interventions should be performed at the hospital location with indicating a low COVID-19 census. Otherwise, they should be referred to the ambulatory surgical center. Low levels of activities of daily living (ADL) due to spinal disorders are considered a risk factor for COVID-19. Therefore, intervention to improve a patient's ADL level is a good option but requires a superior PPE and a gentle procedure. As an intraoperative technique, minimally invasive surgery should be considered. The prone position is preferred to avoid viral transmission by respiratory droplets. The use of electroscopes should be limited in specific situations, and suction should be used with caution to reduce aerosol diffusion. Surgical interventions should be gentle and careful to avoid body fluid spatter and instrument induced injuries.¹⁷⁾

Acute trauma is an emergency indication for peripheral nerve surgery. Additionally, cases with

progressive motor deficits or severe disabling symptoms of pain and paresthesia would be appropriate for surgical interventions.¹⁸⁾

D. Head trauma

Almost all head trauma cases requiring surgery are emergency cases. Therefore, these cases will undergo surgical intervention without awaiting the results of the COVID-19 screening test, as well as endovascular intervention for AIS. This implies that several cases are regarded and treated as suspicious COVID-19 cases. Khazaei et al.¹⁹⁾ reported that some trauma cases were asymptomatic carriers, and were suspected based on the findings of chest computed tomography obtained for the assessment of trauma severity. Furthermore, often infectious diseases coexist with trauma, but are occasionally masked and recognized as posttraumatic fever.^{20,21)}

E. Tumor

Several cases of malignant and benign tumors are considered emergencies.¹²⁾ Emergency tumor surgery with suspicious symptoms of COVID-19 should be performed with the careful use of PPE.⁹⁾ As for surgeries using a transsphenoidal approach, we need to recognize that this approach requires a considerable amount of exposure to aerosols. Many medical societies strongly suggest that the transnasal approach should be avoided when possible.²²⁾ Furthermore, canceling or postponement of surgery is recommended. In emergency cases with pituitary apoplexy, a craniotomy may be performed.²³⁾ If a transsphenoidal approach needs to be undertaken, patients should wear a surgical mask during surgery to reduce aerosols.²⁴⁾ Air-purifying respirators could help reduce the exposure to COVID-19.²⁵⁾

As a postoperative therapy or non-surgical option for glioma, chemoradiotherapy has been recommended, requiring patients to visit medical institutes regularly. However, these regular hospital visits further increase the risk for COVID-19 exposure. To resolve this dilemma, Mohile et al.²⁶⁾ suggested an adjuvant therapy protocol during the COVID-19 pandemic. According to this protocol, shorter courses of radiation therapy should be considered, and temozolomide should be avoided for newly diagnosed patients with glioma with isocitrate dehydrogenase (IDH) wild type and O6-methylguanine-DNA methyltransferase (MGMT) unmethylated characteristics. In these patients, the benefits of using temozolomide are limited; conversely, the risk of treatment and viral exposure is high. For patients with low-grade astrocytoma and oligodendroglioma, in the case of asymptomatic patients, we should consider delaying all therapies to avoid exposure to SARS-CoV-2. For recurrent high-grade glioma patients with the IDH wild type, the use of bevacizumab should be limited

to cases with palliation of neurologic symptoms. In patients with tumors, decisions should be reached by comparing the merits of adjuvant therapy with the demerits of hospital visits increasing the exposure to SARS-CoV2. For patients presenting lymphopenia following temozolomide therapy, close monitoring is essential as this lymphopenia is considered a side effect of temozolomide, even if lymphopenia is a characteristic finding of COVID-19.

F. Pediatrics

In several medical fields, telemedicine has been suggested to avoid exposure to the virus. However, pediatric patients with neurosurgical disorders need to visit the institution for the evaluation of neuroimaging. In the case of situations necessitating neuroimaging with sedation, a postponement should be considered as sedation may require breathing assistance¹¹⁾ and this procedure causes the spread of aerosols.

G. Functional surgery

Functional neurosurgery is categorized into non-emergency operations. However, interventions for super-intractable epilepsy or problems associated with device dysfunctions or battery depletion are categorized as emergency operations.²⁷⁾ Additionally, some patients with low ADL, improved by surgical intervention, could undergo surgery during this period. These cases require decision-making on a case-by-case basis, with a conference among specialists.²⁸⁾

Check Point 7: Psychological Support for Medical Staff and Patients

Globally, the fearful aspects of COVID-19 have been stressful for individuals. The policy and recommendations of each government, as well as suggestions, require patient consideration. People with chronic diseases would be more anxious due to consideration of whether they are at higher risk for COVID-19. To reduce anxiety, some specific medical societies provided information regarding COVID-19 for relevant patients.²⁸⁾ Additionally, clinicians can inform their patients regarding these suggestions to alleviate excessive stress. In addition to patients, medical staff has been under immense pressure owing to COVID-19.²⁹⁾ During this unprecedented pandemic, they often need to make clinical decisions for patients. They are exposed to a high risk of COVID-19 infection.⁴⁾ Each government and institution should have a policy to guard their mental health.

Conclusion

Here, we presented the seven points that neurosurgeons should consider during this COVID-19 crisis. The situations and speed of COVID-19 infections vary

for each country or region. However, every neurosurgeon needs to prepare for this unprecedented crisis.

Conflicts of Interest Disclosure

The authors have no conflicts of interest to disclose.

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