Reconversion of neurosurgical practice in times of the SARS-CoV-2 pandemic: a narrative review of the literature and guideline implementation in a Mexican neurosurgical referral center

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OBJECTIVE The coronavirus disease 2019 (COVID-19) pandemic has forced the modification of surgical practice worldwide. Medical centers have been adapted to provide an efficient arrangement of their economic and human resources. Although neurosurgeons are not in the first line of management and treatment of COVID-19 patients, they take care of patients with neurological pathology and potential severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Here, the authors describe their institutional actions against the pandemic and compare these actions with those in peer-reviewed publications.

METHODS The authors conducted a search using the MEDLINE, PubMed, and Google Scholar databases from the beginning of the pandemic until July 11, 2020, using the following terms: "Neurosurgery," "COVID-19/SARS-CoV-2," "reconversion/modification," "practice," "academy," and "teaching." Then, they created operational guidelines tailored for their institution to maximize resource efficiency and minimize risk for the healthcare personnel.

RESULTS According to the reviewed literature, the authors defined the following three changes that have had the greatest impact in neurosurgical practice during the COVID-19 pandemic: 1) changes in clinical practices; 2) changes in the medical care setting, including modifications of perioperative care; and 3) changes in the academic teaching methodology.

CONCLUSIONS The Instituto Nacional de Neurología y Neurocirugía "Manuel Velasco Suárez" is one of the major referral centers for treating highly complex neurosurgical pathologies in Mexico. Its clinical and neurosurgical practices have been modified with the implementation of specific interventions against the spread of COVID-19. These practical and simple actions are remarkably relevant in the context of the pandemic and can be adopted and suited by other healthcare centers according to their available resources to better prepare for the next event.

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KEYWORDS COVID-19 pandemic; neurosurgery; modification/retraining; actions; SARS-CoV-2

THE coronavirus disease 2019 (COVID-19) pandemic has taken the entire world by surprise, with an unmeasurable loss of life and an unprecedented impact on the world economy. By July 11, 2020, there had been 12,322,395 confirmed cases and 556,335 casualties world-

wide and 6,397,230 confirmed cases in the Americas. In Mexico, there had been 332,929 cases with 36,603 deaths.¹

COVID-19 is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since the first published case reports in December 2019 of atypical pneu-

ABBREVIATIONS ACS = American College of Surgeons; CO-RADS = COVID-19 Reporting and Data System; COVID-19 = coronavirus disease 2019; PPE = personal protective equipment; RT-PCR = reverse-transcription polymerase chain reaction; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2.

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monia in Wuhan City, China,² the infection has become a rapidly spreading disease and was declared a pandemic by the WHO on March 11, 2020.³

In Mexico City, the first case was confirmed on February 24, 2020; a few hours later, another case was confirmed in the state of Sinaloa and then a third case, again in Mexico City.⁵ The first COVID-19–related death occurred on March 18, 2020.⁶ By the end of May, the confirmed cases in Mexico were concentrated mainly in the State of Mexico, Baja California, Sinaloa, Veracruz, and Puebla. However, almost all states had reported cases of COVID-19.⁷

During the pandemic, neurosurgeons have coped with several issues in their practice, such as canceling elective cases and outpatient care by reducing hospital staff to minimize the amount of potential exposure, selection and management of neurosurgical emergencies only, and changes in academic teaching and training methods for residents.^{8–10}

In the following text, we share our institutional experience based on the current international literature as an example and a basis for other resource-constrained neurosurgical centers.

Methods

A review was performed by searching the MEDLINE, PubMed, and Google Scholar databases from the beginning of the pandemic until July 11, 2020, using the following terms: “Neurosurgery,” “COVID-19/SARS-CoV-2,” “reconversion/modification,” “practice,” “academy,” and “teaching.” Only articles of the adult population in the English language as well as epidemiological information from Mexico and Latin America in Spanish were included. Studies related to pediatric neurosurgery were excluded.

Results

According to the reviewed literature, the main adopted strategies on neurosurgical practice during the COVID-19 pandemic were the following: 1) changes in clinical practices; 2) changes in the medical care setting with modifications of preoperative, perioperative, and postoperative care; and 3) changes in medical education and training methods. This information was combined to develop algorithms implemented at our institution that may be useful for other neurosurgical services (Figs. 1 and 2).

Staff Operational Changes

Considering that SARS-CoV-2 RNA is detected in the respiratory tract, feces, blood, and CSF and its neuroinvasiveness in the olfactory epithelium, COVID-19 is considered a highly transmissible person-to-person disease. Therefore, one policy is to avoid large crowds.^{11–14}

Hospitals across the US implemented several measures, such as temperature checks for employees and no-visitor policies for patients to limit cross-infection between patients and healthcare workers.¹⁵ In China, 3.8% (n = 1716 of 44,672) of COVID-19 cases occurred in healthcare personnel, 14.8% (n = 254) of which were severe; in Lombardy, Italy, 20% of the cases occurred in healthcare work-

ers.^{16,17} Subsequent reports suggested that the first nosocomial spread event occurred during pituitary surgery in which 14 people were exposed and infected in China.¹⁸

Changes in Healthcare

On March 13, 2020, the American College of Surgeons (ACS) issued an unprecedented recommendation to “minimize, postpone, or cancel electively scheduled procedures.” As the number of COVID-19 cases increased in the US, the American Hospital Association and the Centers for Medicare & Medicaid Services quickly followed the ACS guidelines and issued similar recommendations.^{19–21}

Different survey-based strategies and scales have been created, such as consulting neurosurgeons’ opinions about the risk of postponing the management of certain diseases. In Italy, some centers were chosen to classify neurosurgical emergencies by temporality into groups of 0 to 6 hours, 6 to 48 hours, 48 hours to 14 days, and > 14 days to define which patients should be taken to the operating room immediately (0–6 hours) and which patients would benefit from evaluation at a designated COVID-19 center before any intervention.²³

On May 15, 2020, an Indian consensus for the practice of neurology and neurosurgery provided recommendations for the management of these patients. In their recommendations, the authors declared that patients should be classified according to surgical priority as having acute (requiring immediate treatment, surgery within 24 hours), subacute (requiring treatment within a maximum of 7–10 days), or chronic (requiring treatment within 1 month) conditions.^{24,25}

Finally, recommendations of the ACS and the European Association of Neurosurgical Societies have been issued for each hospital, healthcare system, and surgeon to carefully review scheduled elective procedures with a plan to minimize elective surgeries and to postpone or cancel scheduled operations, endoscopies, or other procedures.²⁶ COVID-19 has dramatically altered surgical practice patterns worldwide in a short time since the first cases appeared; therefore, the first studies have been published based on experiences and recommendations, predominantly from places initially and substantially affected by the COVID-19 crisis, including China,^{27–29} Singapore, and northern Italy.^{30–33}

Perioperative Management

Preoperative Management

In China, the surgical indications are rigorously evaluated by the surgical team to determine emergency conditions. Non-emergency consultations are documented and followed up through telemedicine or phone calls.²⁹ Telemedical care was reported to have increased in some centers by up to 33%.³⁴

During the preoperative period, a thoracic CT scan and nucleic acid sequencing (reverse-transcription polymerase chain reaction [RT-PCR]) are performed for the preliminary diagnosis of COVID-19; however, the chances of a false-negative test result have been reported to be as high as 16.7%.¹⁷ Patients with positive results are identified as having confirmed COVID-19, and patients with prelimi-

FIG. 1. Algorithm 1. Management of patients not suspected of having COVID-19. Conditions requiring surgery include acute hydrocephalus, postsurgical infection, subarachnoid hemorrhage, endocranial hypertension of tumor origin, compressive spinal cord disease, and traumatic surgical pathology. CU = care unit; lvl = level; OR = operating room.

nary negative results are considered suspect for having COVID-19. Therefore, various levels of protection and specific adaptations to operating rooms occur in a negative pressure environment with access routes specifically designated for all suspect or confirmed cases.³⁰

On April 26, 2020, Singapore issued specific recommendations to the neurosurgical field in which it was emphasized that, depending on epidemiology and local resources, RT-PCR should be conducted in all patients prior to surgery for detection of SARS-CoV-2. All patients

(even if asymptomatic) were considered as potentially infected.^{31,32,35}

Intraoperative Management

The following three environments are considered when the risk of transmission of SARS-CoV-2 in the operating room is high:^{30,31,36}

- 1) all surgeries in which healthcare workers might be exposed to the respiratory or digestive tract;³⁶

FIG. 2. Algorithm 2. Management of patients suspected of having COVID-19. Conditions requiring emergency surgery include hydrocephalus, postsurgical infection, subarachnoid hemorrhage, intracranial hypertension secondary to a neoplasia, compressive medullary disease, and trauma.

- 2) endotracheal intubation and extubation;^{37,38}
 - 3) all surgical procedures with aerosol-generating instruments from potentially virion-contaminated tissues; at this point, it is recommended to limit the use of these devices (motorized drills, electrocautery,^{39–42} lasers,⁴³ and ultrasonic aspirators).⁴⁴
- Given that most hospital settings have multiple operating rooms, it is highly recommended that all COVID-19–confirmed and COVID-19–suspect patients are confined to designated operating rooms.⁴⁵

Postoperative Management

After the surgical procedure was complete, patients

were taken to a negative pressure procedure room where tracheal extubation was performed by the anesthesiology team wearing full protective gear.¹⁵ Patients who had negative test results preoperatively can then be transferred to the general recovery room for postoperative management. Daily assessment of body temperature and respiratory symptoms is mandatory.⁴⁶ Moreover, daily assessment of the body temperature of healthcare staff who are exposed to COVID-19–suspect patients should be implemented.^{46,47}

Change in the Academic and Training Methods of Neurosurgical Residents

The current immediate devastating effects of the pan-

TABLE 1. Procedures performed in evaluation and observation areas of suspected or confirmed COVID-19 patients

Zone & Risk of Contagion	Level of Risk & Hospital Areas	Protection & PPE Levels
Green zone: mild risk	Staff, patients, &/or visitors are considered to be at equal risk of COVID-19 infection as the general population: screening area, hospital access, common areas w/in the institution	Protection level I: attire w/ surgical uniform, exclusive shoes for hospital use, clinical lab coat, mandatory face mask
Yellow zone: moderate risk	Staff, patients, &/or visitors are considered to be at higher risk of COVID-19 infection than the general population: medical offices, clinics, ORs, ICU, non-COVID-19 intermediate care unit, hospitalization areas, MRI room, non-COVID-19 CT scanner room	Protection level II: attire w/ surgical uniform, exclusive shoes for hospital use, clinical lab coat, N95 face mask (mandatory use), examination gloves (1 set), goggles
Red zone: high risk	Staff, patients, &/or visitors are considered to be at high risk of COVID-19 infection & positive diagnosis of COVID-19: monitoring area & COVID-19 care hospitalization area, hospitalization area for highly suspicious patients, area for aerosol-producing procedures, ORs, CICU	Protection level III: attire w/ surgical uniform, exclusive shoes for hospital use, N95 face mask (mandatory use), examination gloves (2 sets), goggles, disposable impervious coat or overall suit, protective face shield, suit up/suit off protocol

CICU = COVID-19 ICU; OR = operating room.

demic not only are evident in the economic and health systems but they also create obstacles in the medicine education programs, including the education of neurosurgical residents.⁴⁸

In this regard, authors at the University Hospitals Cleveland Medical Center in the US reported that resident staffing decreased by 50%, allowing teams to rotate for a week at a time with other residents staying at home and away from exposure.⁴⁹

Of the actions undertaken at the Massachusetts General Hospital and Brigham and Women's Hospital, two focused on academic and learning aspects, such as implementing remote work for clinicians, residents, and support staff, and creating new virtual educational programs for residents.⁵⁰ For resident education, a small proportion (12%) reported cancellation of all instructional sessions within the department while the remaining suggested successful use of a videoconference-based format.⁵¹

Despite the fact that virtual neurosurgical teaching cannot replace practical training, several centers implemented day-to-day strategies to combine the instructional, clinical, and surgical experience through the use of teleconferences concerning specific neurosurgical topics to continue the evaluation of students.^{52–54}

Experience With Implemented Strategies at the National Institute of Neurology and Neurosurgery of Mexico

The Instituto Nacional de Neurología y Neurocirugía “Manuel Velasco Suárez,” a highly specialized neurological and neurosurgical center in Mexico, was designated by the Mexican health secretary as a non-COVID hospital.⁵⁵ Our center implemented specific clinical and hospital procedures for the care of COVID-19–confirmed or COVID-19–suspected infections. These approaches in combination with national guidelines were adapted to our neurosurgical department considering our resources in a limited-budget environment.

Changes to Staff Practice

One applied maneuver (a “worldwide contingency strat-

egy”) was to suspend elective admissions to hospitalization services, as well as ambulatory care, and thus provide only emergency care. At the same time, medical staff prone to developing a serious case of COVID-19 (those with diabetes, hypertension, and immunodeficient conditions) were temporarily withdrawn from hospital activities. New areas were adapted to concentrate COVID-19–confirmed and COVID-19–suspect patients. These areas were strategically separated from those for neurological patients who were not diagnosed with COVID-19. Similarly, exclusive areas were adapted to perform laboratory and imaging studies for both kinds of patients.

Changes in the Healthcare System

In the face of the pandemic, to diminish exposure and contagion risk, the hospital implemented communication through email, phone calls, and video calls to be able to review patients in stable neurosurgical condition. This strategy allowed safe evaluation of patients prior to their relocation. Screening personnel were placed at all hospital entrances to quickly identify suspect cases of COVID-19 before they were admitted to the hospital grounds. Upon evaluation by the screener, a patient was classified as having a suspect, probable, or confirmed COVID-19 diagnosis according to WHO operational definitions.⁵⁶ A patient with suspected or confirmed COVID-19 was immediately sent to the emergency area for evaluation.

To perform these evaluations, some levels of care and protection were established (Table 1). The filter staff then transferred the patient to the appropriate place for them to receive care (Table 2). Surgical indications were rigorously evaluated by the on-call surgical team available 24 hours a day according to the Mexican Society of Neurological Surgery guidelines, as follows:⁵⁷

- 1) class A ++ (requiring immediate or urgent treatment): patients with acute intracranial (rapidly evolving intracranial hypertension with impaired consciousness) or compressive spinal cord pathology;
- 2) class A + (requiring treatment within a maximum of 7–10 days): for example, intracranial tumors with mass effect or progressive neurological deficit without al-

TABLE 2. Clinical data for destination assignment for COVID-19–suspected cases

Clinical Data	Destination
Patient or family member w/ significant clinical RS or fever w/ neurosurgical, neurological, or psychiatric disease; clinically stable	Red zone: consultation rooms w/in the COVID-19 area
Patient or family member w/o RS or fever w/ neurosurgical, neurological, or psychiatric disease; clinically stable	Yellow zone: non–COVID-19 consultation rooms w/in emergency department
Patient w/ low suspicion of COVID-19 w/ neurosurgical, neurological, or psychiatric disease; clinically unstable requiring airway management	Yellow zone: resuscitation area
Patient or family member w/ significant RS or fever w/ neurosurgical, neurological, or psychiatric disease; high suspicion or confirmed COVID-19; clinically unstable requiring airway management	Red zone: CICU
Patient or family member w/ high suspicion of or confirmed COVID-19 w/o urgent neurological, neurosurgical, or psychiatric condition	Red zone: COVID-19 hospitalization area

RS = respiratory symptoms.

Stable and unstable patients without respiratory symptoms or low suspicion of COVID-19 are assigned to the yellow zones, considered to be low-intermediate risk areas. Stable and unstable patients with significant clinical respiratory symptoms or confirmed COVID-19 cases are assigned to the red zones.

tered mental status and having a forthcoming surgical procedure;

- 3) class A (requiring treatment within 1 month): neurosurgical pathology such as a neurological deficit that does not require urgent treatment.

Our hospital suspended surgeries of high aerosol-producing procedures such as transsphenoidal and transmastoid surgeries. In these situations, whenever necessary, patients were required to have negative results on two COVID-19 tests before entering the operating room, and surgical procedures were performed with mandatory use of personal protective equipment (PPE) level III (Fig. 3).

Preoperative Period

Our institution adopted thoracic CT screening as an initial evaluation before the COVID-19 PCR test. CT imaging was jointly evaluated by neuroradiology, infectology, and intensive care specialists based on several items: the COVID-19 Reporting and Data System (CO-RADS)^{58,59} classification (Supplemental Table 1), key clinical data (e.g., respiratory symptoms, fever, and diarrhea), and laboratory parameters (total leukocyte and lymphocyte counts and C-reactive protein, erythrocyte sedimentation rate, D-dimer, ferritin, and lactate dehydrogenase levels).

During the surgical procedure, patients with suspected or indeterminate COVID-19 (CO-RADS category ≥ 3) were considered to pose a high risk of being contagious for the surgical staff; therefore, the use of PPE level III was mandatory. Patients with a CO-RADS category ≤ 2 without respiratory symptoms were considered to be at a low risk of being contagious. Given our limited resources and the emergency situation, RT-PCR COVID-19 testing was postponed until the time of surgery. After testing, a path was cleared from the patient location (either emergency department or ICU) to the operating room to minimize exposure to employees.

Our hospital has 4 neurosurgical operating rooms. Patients at low risk of being contagious were attended at rooms 2, 3, and 4 using PPE level II. In contrast, those at high risk of being contagious were operated on in room 1 using PPE level III.

Intraoperative Period

During endotracheal intubation, the neuroanesthesiology team follows the consensus of the Society for Neuroscience in Anesthesiology and Critical Care and the Society of Vascular and Interventional Neurology guidelines, using acrylic boxes that isolate the head and neck of the patient during orotracheal intubation by the neuroanesthesiologist, with rapid intubation sequence through video laryngoscopy techniques.^{60–62} In all neurosurgical procedures, when possible, the use of aerosol-generating instruments was limited, and an experienced neurosurgeon always led surgical procedures in accordance with preoperative strategies (for reducing bleeding and long surgical procedures). Many adaptations were made (e.g., the use of aspiration at all times while using monopolar and/or bipolar coagulation).

Postoperative Period

All surgical staff discarded their worn robes and gloves securely in the operating room and performed strict hand hygiene before leaving the operating room. To achieve patient transport to the COVID-19–isolated areas, the activation of an internal security code was required to ensure the route and the appropriate cleaning and decontamination maneuvers.

A minimum of 2 hours between surgical procedures was planned to allow the operating room staff time to prepare for a subsequent intervention. During that lapse, rigorous decontamination of the walls, screens, keyboard, cables, monitors, and anesthesia machine was performed. After surgery, patients with a high risk of being contagious were moved to the COVID-19–isolated areas depending on their postoperative status and the need for an advanced airway. In these areas, patients with a pending COVID-19 test were closely clinically monitored and underwent chest CT scanning multiple times.

Academic and Teaching Aspects

At the beginning of the second half of March, our hospital announced the temporary cessation of all academic activities due to the concentration of training residents and

FIG. 3. Proper use of PPE level III in neurosurgical practice with a COVID-19-positive patient.

students in closed spaces. Remote education programs were implemented through virtual educational web-based platforms. All assessment evaluations continued according to previous academic plans.

In the neurosurgery service, a homework scheme was implemented, all journal club sessions were continued, and patient assistance was provided for those who had high-priority surgeries. Resident physicians continued local and national collegiate clinical case sessions with other neurosurgical centers. In addition, there were weekly support neuropsychological sessions for training residents to deal with stress or burnout syndrome. Training in the experimental laboratory with animal models was temporarily canceled in our hospital until epidemiological phase 3 was instituted and national infectious cases declined. Surgical practice for training residents was limited to emergency surgeries with a limited number of residents (senior residents) per procedure.

Despite these changes, the remote education program allowed training residents to continue the academic program on time, which guarantees their timely graduation and conclusion of training programs.

Early Results of Our Implemented Actions

The pandemic changed our practice to protect both patients and staff from infection. We oversaw several significant changes to our neurosurgical practice. For example, we used designated areas for infected patients and created

supplementary ICUs and emergency triage, among other action, which has resulted in only 41 workers becoming infected since the beginning of the pandemic (10.9% of all active personnel at our institution), including resident physicians (19.5%), nurses (60.9%), and support services (e.g., administrative staff, stretcher bearers, and nutritionists). Only 30% of our neurosurgical team was redistributed into COVID-19 medical teams, justifying a rationalization of resources. In addition, only about 21% of the neurosurgery residents have been in quarantine or isolation, taking into account that our hospital is at the center of the pandemic.

Discussion

At our institution, facing the COVID-19 pandemic has posed a great challenge for all healthcare staff, mainly in terms of adapting and reconfiguring our hospital setup and practice methods while continuing to treat patients with neurosurgical pathology uninterruptedly.

Some groups in the US^{8,22} used review panels, checklists, and support questionnaires to perform adequate selection of neurosurgical emergencies, taking into account the knowledge of the underlying pathology and the clinical patient condition at the time of assessment. A similar routine was followed in a general hospital (Fray Antonio Alcalde) in Guadalajara, Mexico, and by the Indian consensus of neurology and neurosurgery practices that were used to estimate the urgency of the surgery.^{24,25} At our institution, the neurosurgical service follows the proposed strategies (algorithms 1 and 2), but, when necessary, each neurosurgical patient was individualized and evaluated in real time given that a large number of neurosurgical pathologies have an unpredictable nature and often need surgical intervention. Moreover, there are patients who do not require emergency neurosurgical management but require hospitalization for the treatment of metabolic, fluid, or electrolyte imbalances and other medical complications.

Regarding COVID-19 testing in patients, we are gathering all efforts to obtain test results of the nucleic acid sequencing test for the detection of SARS-CoV-2 in a timely fashion, trying to adapt a diagnostic algorithm as proposed by Tan et al.⁶³ The chest CT approach has a high sensitivity in detecting patients with moderate to severe COVID-19. One study showed a high positive predictive value and an area under the curve of 0.91 (95% CI 0.85–0.97) for predicting an RT-PCR result and 0.95 (95% CI 0.91–0.99) for the clinical diagnosis of COVID-19.⁵⁸ Also, results of decision tree analysis demonstrate that incorporating chest CT scanning within the urgent imaging protocol used to evaluate neurosurgical patients is a better strategy than not performing such a scan.⁶⁴

Worldwide, there have been several changes in neurosurgical training during the COVID-19 pandemic.^{49,50} Our institution also modified resident education programs despite strict distancing actions by the medical and resident training staff. All academic programs embraced virtual sessions through videoconferencing technology or Neuro-campus sessions to decrease the risk of exposure. All work in the simulated neurosurgical area required appropriate distancing between users.

Contrary to what was observed in Germany, where

emergency admissions decreased by $44.7\% \pm 0.7\%$ during the pandemic, we observed an increase of 30% in medical evaluations in our emergency department.⁶⁵ The number of neurosurgical beds was significantly decreased (approximately a 70% reduction at our center), which is similar to a report from Europe.⁶⁶ This may be due to large neurosurgery centers in Mexico being reconverted as COVID-19 centers, and therefore their patient populations were referred to our hospital.

In general, the relatively few changes performed in our institution in standard operating protocols could have a significant impact on disease transmission without affecting the surgical outcome of patients. The implementation of these protocols may reduce the contagion risk of medical staff. In our center, less than 10% of the medical staff and only 10.9% of all active personnel in our institution have been infected.

In addition, according to our results, 21% of neurosurgery residents were under quarantine or isolation from all other hospital residents, including neurologists, psychiatrists, and other specialties, which is comparable to what has been reported in the literature with 21.2% affected.⁶⁷

It is striking that the nursing staff was the group that was more affected, accounting for 60.9% of registered cases. This high rate is probably due to the fact that nurses work at other hospitals designated as COVID-19 hospitals and the fact that there are more nurses than doctors. Moreover, nurses come in close contact more frequently and closely than do doctors. Unfortunately, due to the lack of data, it was not possible to compare the size of our nursing staff with that of other centers, which was also the same case with hospital support staff (e.g., administrative staff, stretcher bearers, and nutritionists).

On the other hand, there were only 18 COVID-19–positive patients who required emergency surgery since the start of the pandemic, demonstrating that the measures we implemented were quite successful, especially taking into account that we provide an average of 10 neurosurgical emergency evaluations per day.

The flexibility to modify or readapt these protocols will allow us to prepare ourselves for the next steps in the epidemiological COVID-19 situation in Mexico, which the government has referred to as “the new normal.”⁶⁸

Conclusions

Our institution represents a highly specialized center for complex neurosurgical pathologies and neurosurgical training in Mexico and Latin America. We provide various pandemic response interventions undertaken by our country for consideration in response to future pandemics or, in the short term, further peaks in the COVID-19 pandemic. Because our center is not a designated COVID-19 center, we have prepared ourselves to face this pandemic, adapting our resources like most centers in Latin America and the rest of the world. The situation is ever changing, and the pandemic's behavior is evolving constantly, highlighting the importance of being creative and adaptable to every possible scenario. Our goal is to promote the protection of our staff while keeping our neurosurgical service functional. These practical and simple actions are remark-

ably relevant in the context of the COVID-19 pandemic and can be adopted and tailored by other healthcare centers according to their available resources to better prepare for future crises.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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Supplemental Information

Online-Only Content

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