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Challenges of Neurosurgery Education During the Coronavirus Disease 2019 (COVID-19) Pandemic: A U.S. Perspective

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INTRODUCTION

In early December 2019, a number of cases of pneumonia of unknown origin were reported in Wuhan, China. The causative agent was later determined to be a novel strain of coronavirus, virus severe acute respiratory syndrome coronavirus 2. The disease was later named coronavirus disease 2019 (COVID-19). By mid-January, the first case outside of China was reported. Rapidly rising cases prompted the World Health Organization to declare a public health emergency of international concern at the end of January 2020 and declare the disease a pandemic by March 11, 2020.¹ The United States reported its first case on January 20, 2020,² and currently has the greatest number of diagnosed cases worldwide, with more than half a million cases by mid-April.³ The COVID-19 pandemic has impacted every facet of the government and society, including first and foremost our health care system. Although immediate devastating impacts of this pandemic are apparent, secondary consequences are those related to obstacles placed on resident education, including neurosurgery. The purpose of this work is to examine the impact of the pandemic on neurosurgical education and discuss some preliminary ways in which neurosurgical education can cope with these challenges.

STRUCTURE OF NEUROSURGICAL EDUCATION

Although education is a life-long process, neurosurgical resident education comprises a limited time frame during which a resident is to become competent and meet the accepted standards for graduation. Broadly categorized, a neurosurgical education can be divided into clinical and nonclinical arms. We will discuss the impact of the COVID-19 pandemic on each of these and discuss ways to cope with this challenge.

Clinical Experience

Clinical training has long been the foundation of neurosurgical education. Clinical exposure in the operating room as well as preoperative and postoperative care on the wards represent a substantial source of integral knowledge for every trainee. In an effort to preserve resources and reduce hazards for patients, the American College of Surgeons recommended suspension of all

elective surgeries on March 13, 2020.⁴ Certain states, such as Texas, also have issued executive orders mandating health care facilities to postpone elective cases with legal repercussion for violators.⁵ Taken together, the neurosurgical society is currently witnessing an unprecedented decrease in clinical practice.

To address the COVID-19 pandemic, the health care system has shifted a majority of its resources to accommodate the influx of patients with COVID-19 and the increased use of personal protective equipment. In an effort to face this crisis, health care institutions have implemented a series of interventions. Those are largely directed to preserve resources such as personal protective equipment, rearranging staff (including residents) to maximize efficiency and minimize exposure risk, and creation of COVID-19-specific intensive care units. This translated into the decision to cancel neurosurgical elective cases. Furthermore, nonemergent surgical consultations have witnessed a decrease, likely due to decreases in the number of patients visiting the emergency departments for chronic complaints. Lastly, outpatient clinics also have experienced a decrease, albeit not as prominent, in the number of patients seen. Surgical residents have long reaped the learning benefits of all previously mentioned aspects of training. Basic nonoperative skills such as performing physical examinations, dealing with consultations, and managing the ward/intensive care unit have been negatively impacted by such changes. More evidently, the large drop in the number of cases invariably witnessed by all programs due to elective surgery cancellations takes a toll on resident technical training. This decrease in operative intervention affects not only the technical training of surgical residents but also the postoperative management experience that comes with elective surgeries.

Although replacing hands-on clinical experience is not possible, certain steps can be taken to cope with these challenges. Although elective surgical interventions have been cancelled, there is a subset of patients that requires urgent operative care in certain instances, such as progressive neurologic decline. Our institution, as well as others, has implemented a scoring system to determine the necessity and urgency of surgeries.^{6,7} This, along with an ongoing surveillance of hospital resources and disease spread, makes it still possible to conduct surgeries that cannot be

Key words

- COVID
- Education
- Neurosurgery

Abbreviations and Acronyms

- AANS:** American Association of Neurological Surgeons
- ABNS:** American Board of Neurological Surgery
- CNS:** Congress of Neurological Surgeons
- COVID-19:** Coronavirus disease 2019
- SNS:** Society of Neurological Surgeons

Table 1. Summary of Alternative Learning Methods During the COVID-19 Pandemic for Neurosurgery Residents

Impacted Learning Categories	Alternative Learning Resources
Operative experience	<ul style="list-style-type: none"> • No adequate replacement • Continuing with urgent/emergent surgeries
Patient consultation/follow-up	<ul style="list-style-type: none"> • Telemedicine patient evaluation • Maintaining clinic visits at a reduced volume
Subspecialty/resident conferences	<ul style="list-style-type: none"> • Virtual meetings
Departmental Grand Rounds	<ul style="list-style-type: none"> • Virtual Grand Rounds through available online platforms • The opportunity to attend other subspecialty grand rounds
Didactic lectures	<ul style="list-style-type: none"> • CNS/AANS resources • The Rhoton Collection • <i>Neurosurgical Atlas</i> • Other eLearning venues including vendor-sponsored webinars, subspecialty tele-conferences, social media platform discussion forums

COVID-19, coronavirus disease 2019; CNS, Congress of Neurological Surgeons; AANS, American Association of Neurological Surgeons.

postponed beyond certain time frames. Furthermore, although clinic experience has suffered, partly because of patients' reluctance to visit a health care institution, current technology can compensate and bridge this gap. Alternatives include phone visits and telemedicine, including video calls. Although these do not offer the same experience as traditional visits, they still allow residents the opportunity to evaluate patients, review imaging, and form a differential diagnosis and a plan. The residents also can continue to conduct postoperative patient care. Furthermore, telemedicine is being used in health care (i.e., stroke telemedicine) on a routine basis for certain pathologies, and resident experience with telemedicine provides an educational opportunity to participate in an advancing field.⁸

Nonclinical Experiences (Structured Learning/Research/Conferences)

Neurosurgical education has a storied history of formal didactic sessions and educational conferences. These include subspecialty conferences, resident conferences, Grand Rounds, and morbidity and mortality sessions. The COVID-19 pandemic has forced the cancellation of face-to-face meetings to reduce exposure risks. As the neurosurgical community endeavored to maintain the safety of its trainees and members, numerous cancellations occurred in the United States, including the annual meetings of the American Association of Neurological Surgeons (AANS) and the Society of Neurological Surgeons (SNS). In addition, impacting resident education was the cancellation of the SNS 2020 Junior Resident Courses and the postponement of the American Board of Neurological Surgery (ABNS) Annual Primary Examination on March 12, 2020. Globally, the World Federation of Neurosurgical Societies has also endorsed cancellation of worldwide meetings until at least July 31, 2020.

In the modern era, medical training has profoundly benefited from eLearning opportunities. Neurosurgical training is no different, as there are numerous online training tools to advance residents understanding of neurosurgery through anatomy

resources, case illustrations, operative videos, and a wide breadth of peer-reviewed publications.

The educational hurdles placed by the COVID-19 pandemic has emphasized the importance of online educational tools by allowing continued learning without increasing exposure risks. The AANS and the Congress of Neurological Surgeons (CNS) have long shown an intense dedication to the education of its resident population. In coordination, they have opened access to online lecture series, virtual visiting professor conferences, and created COVID-19 information hubs.

Along with the previously mentioned resources, the SNS provides online videos that expose the viewer to patient assessment pearls, medical management techniques, and operative approaches. There are numerous other well-used online resources that provide extensive access to nontechnical skill training, neuroanatomy, neuroradiology, operative approaches, and post-residency transition information, such as the *Neurosurgical Atlas*, the Rhoton Collection, and the respective journals of neurosurgical organizations. **Table 1** summarizes the alternative aforementioned learning resources.

CONCLUSIONS

The current COVID-19 pandemic has created devastating impacts on the global population, health care system, and economy. In today's unique environment, it is paramount that neurosurgical education evolves to ensure safety of its trainees as well as effective training. Now more than ever, resident trainees must be self-disciplined, creative, and resilient. Fortunately, the neurosurgical community has made a tremendous adjustment through the use of modern communications tools. Online conference platforms have allowed the continuance of educational conferences and patient case discussions. These virtual meetings, although with limitations, have created a helpful alternative to face-to-face meetings and hands on experience. Virtual conferences, telemedicine, and online educational resources allow the neurosurgical resident to continue a dedicated approach to their education, and more importantly, to the care of our patients.

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