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New adaptation of neurosurgical practice and residency programs during the Covid-19 pandemic and their effects on neurosurgery resident satisfaction and welfare at the National General Hospital, Jakarta, Indonesia

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ABSTRACT

Introduction: Many institutions in numerous countries have made changes in their health care services during the COVID-19 pandemic. One change has been to reduce elective neurosurgery cases, which has impacted neurosurgery education. Published literature is lacking about the healthcare services, education, and residents' well-being during adaptation to the pandemic, especially in national referral hospitals in developing countries.

Methods: We conducted a cross-sectional study on current neurosurgical services during 2020. We evaluated 34 neurosurgery residents in Cipto Mangunkusumo National General Hospital using a self-made questionnaire to determine the effects of the COVID-19 pandemic on their surroundings, education process, and satisfaction with the currently adapted education program. We used the modified Maslach Burnout Inventory to assess burnout in the residents before and during the pandemic.

Results: Neurosurgical residents spent more time studying neurosurgical theory (Mode 1–1.5h/day, p < 0.05) but spent less time learning neurosurgical skills (Mode 30 min–1 h/day, p < 0.05) compared to before the pandemic. The resident satisfaction mean score (scale 0–10) was 7.58 for live surgery and 8.53 for the microsurgical skills lab training program. On a scale of 1–10, the residents’ stress level increased after the pandemic but the change was not statistically significant (6.61/C6 1.87, p > 0.05). The Modified Maslach Burnout inventory score was 3.02/C6 3.74 during the pandemic, and increased from before the pandemic (2.41/C6 3.18), but the difference was not statistically significant.

Conclusion: The COVID-19 pandemics have reduced the working hours and the clinical exposure of neurosurgical residents. Fortunately, this pandemic has led to a new opportunity to find many suitable learning methods which may decrease the risk of burnout. The psychological burden of residents is still worrisome, and planned management is necessary to sustain resident performance.

1. Introduction

Coronavirus disease 2019 (COVID-19) was first reported in late 2019 [1], spreading locally in Wuhan, China, but then being declared a global pandemic on March 11th, 2020, by the World Health Organization (WHO) [2]. As of November 21st, 2020, a total of 493,308 cases and 15,774 (3.2 %) deaths have occurred in Indonesia, according to the Ministry of Health’s registry [3]. Jakarta is the epicenter of the epidemic in Indonesia, with a total of 8,444 active cases and 2,515 deaths [3, 4].

During adaptation to the “new normal” period in Indonesia, Cipto Mangunkusumo National General Hospital, located in Jakarta, has been trying to adapt to the pandemic while continuing to provide optimal healthcare services as a national referral hospital. The existence of COVID-19 and the reduction in the number of neurosurgical procedures performed has changed the learning process for the hospital's neurosurgery residents, shifted the regulation of working hours among staff and residents, and altered the flow of hospital services. These issues have emphasized the importance of estimating the best options for implementing safe and effective clinical practice while continuing the neurosurgical education process.

The aim of this study was to describe our trends in neurosurgical practice and surgical cases before and during the pandemic. We also provide data on our neurosurgical residents in terms of their demographics and their perception of COVID-19 and its impact on them, as
well as the effects of the pandemic on the risk of burnout among these residents.

2. Material and methods

We conducted a cross-sectional study on all 34 neurosurgical residents at Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia. We used a self-made questionnaire comprising 24 questions and divided into four sections (COVID-19 Exposure, COVID-19 perception, Education during COVID-19 pandemic, and Mental Health During pandemic) and we used the Modified Maslach Burnout Inventory (MBI) [5, 6] to collect data about how the COVID-19 Pandemic situation affected the residents’ educational experience, surgical skills, satisfaction with the learning process conducted during the pandemic, and risk of burnout. We ask all residents to recall the workload and activities before the pandemic announcement (January–March 2020) and ask them to compare the situation during the pandemic (May–October) in order to assess the impact of the pandemic on residency training after 6 months of a modified schedule. All residents took the questionnaire during their on-service period, after finishing their services. The questionnaire was validated, all components are valid (Emotional Fatigue $r = 0.57$, Personal Achievement $r = 0.53$; Depersonalization $r = 0.72$) and reliable (Gronbach’s Alpha for Emotional Fatigue = 0.764; Personal Achievement = 0.71; Depersonalization = 0.757).

The data obtained were analyzed for normality using Kolmogorov-Smirnov and Shapiro-Wilk analysis. Comparative analysis for the Modified MBI Questionnaire before and after the pandemic was conducted using the T-test for data with a normal distribution or the Wilcoxon test for data without a normal distribution. The Modified MBI consists of 22 yes-no questions and is divided into 3 sections (Emotional fatigue, personal fulfillment, and depersonalization). Each yes question scores 1 point, with a maximum of 22 points. Each section score was calculated and presented as the mean and standard deviation. Each section of the Modified MBI Question before and during the pandemic was compared using a comparative analysis depending on the distribution of data. The total score for each modified MBI index was reported as mean ± standard deviation (SD). $P$ values $\leq 0.05$ were considered statistically significant. All data analysis was conducted using IBM SPSS Statistics software (Version 25.0). Our study, which involving our neurosurgical residents already got an ethical clearance from The Ethical Committee of Faculty of Medicine, Universitas Indonesia no: KET-711/UN2.F1/ETIK/PPM.00.02/2020, Protocol No. 20-07-0769.

3. Results

The Department of Neurosurgery at Cipto Mangunkusumo National General Hospital, Faculty of Medicine Universitas Indonesia, performed an average of 864 elective cases and 104 emergency cases annually from the year 2015–2019. In 2019, we operated on 1006 neurosurgical cases. Oncology has the most cases of all surgeries (385 cases, 38.2 %) followed by vascular surgery (232 cases, 23 %). Overall, 69.4 % of all operative cases were elective surgeries. Throughout 2019, only 44 case were functional surgeries. The impact of COVID-19 was a significant decrease in operative cases, especially elective surgeries (Figure 1).

![Figure 1](image_url)

Figure 1. A. Neurosurgical cases at Cipto Mangunkusumo Hospital based on Urgency. Elective cases increased after the government loosened the large-scale social restriction. B. Gamma Knife Patients at Cipto Mangunkusumo Hospital, 2020. A significant increase in Gamma Knife Radiosurgeries were evident starting in May 2020. Black arrow: The Indonesian Government implemented large-scale social restrictions to the public. Black arrowhead: New adaptation.
The demographic information of our residents at Cipto Mangunkusumo National General Hospital was presented in Table 1. Most of our residents were 29 years old (n = 9; 26.5 %), with the range of 27–36 years old. Of 34 residents, 5 of them (14.7 %) were female. Until now, 26.4 % of residents are in their 4th PGY.

Table 2 showed the distribution of responses regarding the questionnaire given to neurosurgical residents. This data revealed that many neurosurgical residents were ever dealing with suspect COVID-19 patients (91.2 %), but 44.1 % of all residents did not feel confident about managing COVID-19 patients. About 11.8 % of neurosurgery residents felt unsafe to live with their family, and half of the neurosurgery residents were unsure about the safety of their family, knowing they were physicians. Despite most residents (91.2 %) felt that the time for studying during the COVID-19 pandemic was not decreasing, they felt that time for studying neurosurgical skills decreased (82.4 %). Almost all (97.1 %) of residents said that microsurgical skills labs was beneficial for learning practical skills, but half of them agree that skills lab could not replace learning skills in the operating theatre.

Table 3 explained about time spent on theoretical and practical studies compared before and during the pandemic. The time for learning theory has increased during pandemics (p < 0.05), while the time to practice skills (microsurgical suturing, microsurgical drilling, and surgical assistance or guidance) has decreased during pandemic (p < 0.05).

As we see in Table 4, there was a slight increase in residents’ stress levels during the pandemic, although not statistically significant (p = 0.279). In addition to this questionnaire, we also used the Modified MBI to assess the residents’ possibility of burnout before and during the pandemic to establish more specific aspects regarding the residents’ stressors. Table 5 shows that the value of the Maslach Burnout Inventory (MBI)'s emotional aspects regarding the residents managing neurosurgical patients is decreasing MBI ed = 0.331, p = 0.05), while the time to replace the necessity of learning neurosurgical skills during the pandemic is decreasing MBI ed = 0.257, p = 0.05).

4. Discussion

4.1. Neurosurgery resident working shift during pandemic

Throughout the COVID-19 pandemic, the neurosurgery residency program continues to run although several adjustments have been made to the residents’ working hours and shifts. At present, the program includes 14 teaching staff members and 35 residents. Our neurosurgery department formed two separate teams as a strategy to conduct daily patient services during this era. One team works for two consecutive weeks and the other team then works the next two weeks. The total of 12 junior residents, 9 intermediate residents, and 7 senior residents in the department are assigned to each team as 6 junior residents and 4 to 5
intermediate residents, while all 7 senior residents attend health services every day and supervise both teams. Our senior resident shift is quite similar to that described by Kessler et al., where the senior residents are always in the operating theatre and on standby for operations; however, the difference is that our senior residents work from the hospital every day [7]. Bambakidis et al. and Fernandes et al. also explained that the number of active residents was decreased by 50% to minimize COVID-19 exposure [8, 9]. Therefore, a team would rotate once a week or once every two weeks, as we did at Cipto Mangunkusumo National General Hospital. From pre-pandemic and during pandemic, total working hours for residents in 1 week ranges from 68-80 h, consist of 40 h of daily working hours, weekly and one or two night shift (14 h per shift) weekly. It is expected that setting working hours <80 h a week can be one of many factors that could reduce the risk of burnout; Therefore, Manageable shift could be the solution to prevent burnout in physician [10].

4.2. Neurosurgical education during the COVID-19 pandemic

Knowledge-based academic activities, such as scientific meetings, journal reading, and case presentations, were done online through Zoom. Service-based academic activities, such as the outpatient clinic, neurosurgical ward, and surgeries continued as usual, but with a reduced number of participants due to shift schedules. Academic evaluations, such as tests or result presentations, were done online through teleconferencing media. Our staff members are continuously making efforts to provide education for the residents. We also use virtual learning methods to provide residents with study materials in areas such as neuroanatomy and for discussion of topics on neurosurgery. This is often done during lunchtime with all the staff members. Zoia et al. and Clark et al. stated in that, in this pandemic, the best approach is to allocate time to increase scientific activities and education to the residents via online teleconferences [11, 12]. The lack of practice opportunities adds more time for didactic lectures. This is similar to what Pelargos et al. said, as the addition of time at home also provided the residents with increased opportunities to learn from lectures as the previously high workload reduced the time to study or have discussions with the attendings [13].

In the early days of the COVID-19 pandemic, almost all elective operations were postponed. Therefore, to maintain the learning process of our residents during the pandemic, beginning in June 2020, we implemented live surgery as a useful way to learn operative techniques. Video transmission of a neurosurgical procedure from the operating theatre to a conference room or mobile phone is the simplest and most efficient way to conduct live teaching of surgery during this pandemic era. With this live surgery, the residents can learn from and interact with the attendings during the operation, while maintaining physical distancing [7, 8]. Therefore, the benefits of education, the benefits of services, and the safety of the health workers in this pandemic era are achieved [7]. However, the benefits and disadvantages of live surgery must still be considered, because if live surgery is to be conducted with professionalism, this tool could be very promising as a future education alternative [7]. As we can see from the data, live surgery could be helpful in a pandemic situation, but it cannot be a permanent replacement for residents to develop their surgical skills [9]. Fortunately, since May 2020, our elective cases have also increased, along with the loosening of regulations by the government.

Prior to the pandemic, a structured schedule had been prepared for skills training for neurosurgical residents in the skills lab. There, the residents practiced skills such as chicken wing suturing, gauze suturing, eggshell drilling, and deep-seated micro suturing and micro drilling. Neurosurgery skills training is also included as operating assistance or operation guidance depending on the number of cases. During a pandemic, the arrangements for neurosurgery residents to participate in operational activities are prioritized for neurosurgery residents at the

Table 3. Neurosurgery residents’ educational activities before and during the COVID-19 pandemic.

| Educational Activities                                      | Before Pandemic N (%) | During Pandemic N (%) | Wilcoxon Test (p-value) |
|-------------------------------------------------------------|-----------------------|-----------------------|-------------------------|
| Time spent per day learning neurosurgical theory             |                       |                       |                         |
| <30 min                                                     | 4 (11.8)              | 0 (0)                 | p < 0.05, More time spent on learning theory during pandemic. |
| 30 min-1 h                                                  | 8 (23.5)              | 5 (14.7)              |                         |
| 1 h-1.5 h                                                   | 14 (41.2)             | 3 (8.8)               |                         |
| 1.5 h-2 h                                                   | 6 (17.6)              | 6 (17.6)              |                         |
| >2 h                                                        | 2 (5.9)               | 20 (58.8)             |                         |
| Time spent per day learning neurosurgical skills             |                       |                       |                         |
| <30 min                                                     | 3 (8.8)               | 8 (23.5)              | p < 0.05, More time spent on learning neurosurgical skills before pandemic. |
| 30 min-1 h                                                  | 3 (8.8)               | 13 (38.2)             |                         |
| 1 h-1.5 h                                                   | 8 (23.5)              | 3 (8.8)               |                         |
| 1.5 h-2 h                                                   | 3 (8.8)               | 6 (17.6)              |                         |
| >2 h                                                        | 17 (50)               | 4 (11.8)              |                         |

*We compared time spent per day on learning neurosurgical theory and learning neurosurgical skills before and during the pandemic. Wilcoxon test compare mean time spent on theory/practice before and during the pandemic.

Table 4. Neurosurgery residents’ stress level before and during the COVID-19 pandemic.

| Mental Health                                                                 | Before the Pandemic (Mean ±SD) | During the Pandemic (Mean ±SD) | Wilcoxon Test (p-value) |
|--------------------------------------------------------------------------------|---------------------------------|--------------------------------|-------------------------|
| Rate your stress level on a scale of 0–10 before and after the pandemic.       | 6.26 ± 1.72                     | 6.61 ± 1.87                    | 0.279                   |

Table 5. Modified Maslach Burnout inventory before and during the COVID-19 pandemic.

| Aspect                        | Mean Resident Score before Pandemic | Mean Resident Score during Pandemic | Kolmogorov-Smirnov Normality Test | Wilcoxon Signed Rank Test (p-test) |
|-------------------------------|-------------------------------------|------------------------------------|----------------------------------|-----------------------------------|
| Emotional Fatigue             | 1.47 ± 1.74                         | 1.76 ± 1.93                        | <0.05                            | 0.331                             |
| Personal Fulfillment          | 0.55 ± 0.99                         | 0.64 ± 1.25                        | <0.05                            | 0.414                             |
| Depersonalization             | 0.38 ± 0.98                         | 0.38 ± 0.47                        | <0.05                            | 0.257                             |
| Total                         | 2.41 ± 3.18                         | 3.02 ± 3.74                        | <0.05                            | 0.113                             |
independent level, with the consideration that they will soon graduate and still require exposure to more cases as experiences that will be useful when they graduate. The shift adjustment to the junior neurosurgery residents is also the reason for the reduction in time available to practice neurosurgical skills.

On a temporary basis, our residents (94.1%) agreed that lectures via the online platform can perform as well as they did before the pandemic. This can be seen from the responses of students who argued that online learning could replace offline education (85.3%). For skills practice, most residents stated that microsurgical lab training (97.1%) and live surgery (94.1%) were useful as alternative ways to learn practical skills from our attendings during the pandemic.

We routinely conduct case discussions every Monday and Thursday, and these are attended by all residents since the pandemic. They can discuss the case with our neurosurgery consultant regarding the theory and the application of the theory. During the pandemic, journal reading increased from two times a week to five times a week with 1-2 h sessions, thereby increasing the learning of evidence-based medicine in the field of neurosurgery. Live surgery attended by all neurosurgery residents also helps interactions with educators, which can improve residents’ surgical knowledge. That improvement, in turn, helps improve their cognition of neurosurgical techniques and neurological anatomy (e.g., searching for supporting journals) [9]. Jack et al. stated that, with the resident work hour restrictions, this method can be used to augment education and surgical experience. Live surgery could be used as an educational tool, as well as to evaluate the residents’ surgical skills [9]. Deora et al. stated that the lower cost of electronic media and information makes them very popular tools among residents, although each resident still needs better hands-on surgical exposure [14]. In a study reported by Rana T et al., nonsurgical specialty residents were more comfortable using telemedicine than surgical residents. This study also stated that the COVID-19 pandemic disrupts their surgical training, according to 50% of surgical resident respondents [15].

4.3. Burnout in neurosurgical residents

Although residents have more spare time due to their shortened duty hours and reduced outpatient and surgery shifts, the burnout level was higher than before the pandemic, even though the results were not statistically significant. Increases were seen during the pandemic in the scores in all three sections: emotional fatigue, personal fulfilment, and depersonalization.

The research by Khalaflah et al. showed that the mean MBI score among neurosurgery residents was 7.86, larger compared to our institution (3.02) [16]. They explained that although the residents reported fewer work hours, they have decreased neurological ability and are concerned that this pandemic will affect their surgical milestones. Many programs have halted elective cases to maintain the social distancing guidelines imposed by their countries, and this affects the residents’ opportunities to train their microsurgical skills [17]. Our survey also showed that neurosurgery residents from our institution are suffering from reduced time and opportunity to learn more skills and that they felt that their neurological skills were decreasing. Pennington et al. also stated that, despite the decreases in case volumes and experience, the residents received no compensation if they did not meet the ACGME case minimums, and this could be one of main stressors among the residents during this era [16]. Study by Alhaj et al. also showed that almost all neurosurgery residents found that the neurosurgery training during COVID-19 pandemic was affected. Almost 80% residents felt that daily studying hours was affected. The significant decrease in neurosurgical cases, as well as in our department is decreasing the residents’ exposure to outpatient encounters [18]. Since the pandemics started, our resident had gotten additional financial support from government, that could lead to increase resident welfare during pandemic.

Only several studies reported on physician burnout during and before the COVID-19 pandemic. The evidence on factors that were contributing to burnout during this pandemic is limited. This study shows that the risk of burnout before and during pandemics is not statistically significant. Wu et al., in their study, reported that 62% of respondents did not feel more burnout than before the pandemic, and only about 23% of respondents felt more burnout than before the pandemic. They thought that burnout might appear to be less frequent in physicians who worked at the frontline than other physicians [7, 13]. Despite these results, the prevalence of burnout among physicians was still high compared to before the pandemic.

Every hospital has its subculture and microculture resulting from different training, organizational, and clinical priorities among medical and surgical specialties. During COVID-19, every hospital has to remake its internal structure on managing a critically ill patient. The pandemic could increase the risk for the cultural clash (between specialties) due to the differences in perceived priorities among neurosurgeons and other specialists. The clash between specialties might well justify an increase in the Modified Maslach Burnout Inventory score [19]. In our hospital, every surgical specialty had individualized operating theatre and inpatient ward, so the competition between specialties rarely happened. Previous neurosurgical residents had varying hours of work, workloads, and clinical experience. Currently, the risk of exposure to COVID-19 is too high, thus requiring restrictions on hands-on and clinical exposure. Our survey findings reflect this; the residents indicate that they have less time to practice skills compared to before the pandemic. At present, live surgery and microsurgical skills lab training remain acceptable, but they cannot replace hands-on experience directly in the operating room. Nevertheless, our residents were quite satisfied with how live surgery and the microsurgical skills lab were conducted at our institution, as the survey showed a mean score for live surgery and skills lab satisfaction of 7.58 and 8.53, respectively. This is because, even before the pandemic, neurosurgery was one of the most rigorous and difficult programs. Therefore, neurosurgery residents may, in general, tend to have a stronger mentality to deal with adaptations.

Today, Cipto Mangunkusumo National General Hospital manages the surgical and non-surgical care and treatment of suspected and confirmed COVID-19 patients in a separate building; this could be the cause of the increased MBI score after the pandemic. During the pandemic, the workflow and rescheduling process became more complicated compared to before the pandemic. Difficulty in using personal protective equipment and the necessity to maintain hygiene before and after entering the COVID-19 treatment building could add additional burdens to neurosurgical residents when performing neurological healthcare, operative scheduling, and patient visits. Providing adequate PPE to neurological residents should be the top priority because lack of PPE significantly correlated with increased burnout among residents [18]. Sharif et al. stated that the requirement of social distancing and self-quarantine in this COVID-19 pandemic might cause significant changes in our lifestyle. These changes affect not only the neurological staff but also their family. Many families felt unsafe for healthcare workers to go to work, especially with a limited supply of PPE [20]. Therefore, providing adequate PPE could give a feeling of self-protection to healthcare workers and their families [20]. We have received proper PPE and donation from non-profit organization, so that all resident who gave healthcare services can use the proper PPE as with the recommendation given. We hope that with this method can help to lower the burnout rate in healthcare workers. A study from Gana et al. stated a lack of agreement on what PPE should be adopted in various neurological circumstances [21]. Ensure the protection of the entire healthcare staff is essential. The use of adequate PPE could avoid accidental contamination from COVID-19 patients due to late recognition of their infection status [21].

The strength of this study is that it describes the condition of neurosurgical services, the education process, and the residents’ perspectives and welfare during the pandemic in a national referral center. Until now, only three studies that explored physician burnout during this pandemic using the Maslach Burnout Inventory Score as their indicator [8, 14, 16]. In addition, very few studies have discussed the effect of the pandemic on
neurosurgery education in developing countries. One study that has looked at these issues was conducted by Deora et al., who described the neurosurgery resident perceptions in low-to-middle-income countries [14].

Our study also has several limitations. One is that resident burnout could be underdiagnosed, as the workload could be reduced during this pandemic. Moreover, the residents have more spare time compared to before the COVID-19 pandemic. Another limitation is that our study only includes a limited number of neurosurgical residents at our institution. A third limitation is that this study did not consider several factors that could be potential confounders regarding the residents' mental health, such as family or financial problems before and during pandemics. Despite those limitations, this study made an unprecedented step in appraising our neurosurgical residents, quantitative and qualitatively, during the COVID-19 Pandemic. Therefore, this research will help to bridge the gap between unstructured commentaries and carefully designed multicentric studies. In the future, multi-institution studies could be very beneficial for evaluating the new study programs implemented during the COVID-19 pandemic and their effects on resident burnout, perception, educational progress, and perhaps even the effect of the residents' external environments on their performance. In addition, more studies should evaluate the residents' operative skills and theoretical knowledge. This research will help neurosurgery departments to determine the best curriculum for neurosurgery residents, without losing any of the values the training offered before the pandemic. All this information could also be useful for other departments.

5. Conclusion

This pandemic has debilitating effects on the residents' educational process. Moreover, the pandemic will potentially change the academic system and residency. The limited surgical experience and reduced clinical exposure are worrying. Therefore, a balanced midpoint or substitute is crucial. Fortunately, this pandemic has also provided us with ways to find new and efficient methods of learning and communicating, of generating more savings, and of maintaining the neurosurgical residents’ competence. Lastly, transmission of infection within family members is a serious concern and should be a consideration for all residents, doctors, and the hospital to keep everyone safe.

Declarations

Author contribution statement

Setyo Widi Nugroho: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Ivan Pradhana: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Kevin Gunawan: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

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