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Neurosurgical Services in the Northern Zone of Sarawak in Malaysia: The Way Forward Amid the COVID-19 Pandemic

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■ **BACKGROUND:** The novel coronavirus disease 2019 (COVID-19) pandemic has set a huge challenge to the delivery of neurosurgical services, including the transfer of patients. We aimed to share our strategy in handling neurosurgical emergencies at a remote center in Borneo island. Our objectives included discussing the logistic and geographic challenges faced during the COVID-19 pandemic.

■ **METHODS:** Miri General Hospital is a remote center in Sarawak, Malaysia, serving a population with difficult access to neurosurgical services. Two neurosurgeons were stationed here on a rotational basis every fortnight during the pandemic to handle neurosurgical cases. Patients were triaged depending on their urgent needs for surgery or transfer to a neurosurgical center and managed accordingly. All patients were screened for potential risk of contracting COVID-19 prior to the surgery. Based on this, the level of personal protective equipment required for the health care workers involved was determined.

■ **RESULTS:** During the initial 6 weeks of the Movement Control Order in Malaysia, there were 50 urgent neurosurgical consultations. Twenty patients (40%) required emergency surgery or intervention. There were 9 vascular (45%), 5 trauma (25%), 4 tumor (20%), and 2 hydrocephalus cases (10%). Eighteen patients were operated at Miri General Hospital, among whom 17 (94.4%) survived. Ninety percent of anticipated transfers were avoided. None of the medical staff acquired COVID-19.

■ **CONCLUSIONS:** This framework allowed timely intervention for neurosurgical emergencies (within a safe limit), minimized transfer, and enabled uninterrupted

neurosurgical services at a remote center with difficult access to neurosurgical care during a pandemic.

INTRODUCTION

Borneo island is the largest island in Asia and the third largest island in the world.¹ Sarawak, also known as the Land of Hornbills, is located in the Northwest region of Borneo island, housing a population of 2.8 million across a span of 124,450 km².² Miri General Hospital (MGH) is the main referral center in the northern region of Sarawak, which serves a population of 451,132 people.³ This hospital caters not only to the population of Miri district but also to the districts and subdistricts of Limbang, Lawas, Marudi, Sibuti, Ulu Baram, Niah, Suai, Long Lama, and Bario.⁴

Transport and communication remain a major challenge in the northern region of Sarawak in Malaysia. The location is sparsely populated with a density of 12 persons/km², and many of them have difficulties accessing Miri hospital, including those staying at regions where a boat is the only means of transportation.^{3,5} Hence it is near impossible for patients with neurosurgical emergencies requiring immediate intervention to reach our neurosurgical center at Sarawak General Hospital, which is situated 798 km away in the Kuching city (Figure 1). The emergence of the coronavirus disease 2019 (COVID-19) pandemic has imposed an even greater obstacle to an already difficult transfer process.

Most neurosurgical emergencies require a prompt consultation and occasional intervention for an optimal outcome. Time until neurosurgery and distance of transport to the center with appropriate neurosurgical care significantly predict mortality and outcomes.⁶⁻⁸ Approximately 10% of patients with a mean transfer time of just over 5 hours encounter a drop in Glasgow Coma Scale during transfer.⁹ Those who experience delays of 4–5 hours before

Key words

- COVID-19
- Neurosurgical emergencies
- Pandemic
- Remote center

Abbreviations and Acronyms

COVID-19: Coronavirus disease 2019
MEDEVAC: Medical evacuation service
MGH: Miri General Hospital

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their surgery have a higher mortality rate compared to those who present to the neurosurgical service directly. Distance to the neurosurgical center is one of the main factors that causes delay in the treatment of neurosurgical emergencies.¹⁰

Traveling by land from Miri to Kuching takes an average 12–15 hours because of the distance, coupled with poor road conditions. Air transfer shortens the duration but has its own inherent limitations. In Sarawak, there are 2 modes of air transfer available, either the usual commercial flight or a more urgent transfer, the airborne medical evacuation service (MEDEVAC) by helicopter. Critically ill patients are transferred by MEDEVAC.

There are 2 helicopters chartered for all the emergency medical evacuations in Sarawak. However, this service is limited by the availability of helicopters when the need for transfer arises, in addition to the environmental and weather conditions for air

travel. The state has an average rainfall of 3300–4600 mm per year. Approximately 30% of the days in a year are rainy days.^{11,12} Furthermore, the mountainous topography at this part of the island with low clouds, strong winds, and occasional turbulence creates more obstacles for the medical team to travel safely in helicopters.

METHODS

All of the earlier mentioned challenges compromise patient care, and the health care system incurs significant costs. To mitigate these, 2 neurosurgeons from Sarawak General Hospital were stationed at MGH on a fortnightly rotational basis. This was done to ensure in-house delivery of neurosurgical services, with an aim to minimize the time until neurosurgical intervention and optimize patient outcomes.

Table 1. Distribution of Neurosurgical Cases Requiring Emergency Surgery/Intervention in the Initial 6 Weeks of Movement Control Order

Disease Profile	Number	%
Vascular	9	45
Hemorrhagic stroke	8	
Dural arteriovenous fistula	1	
Trauma	5	25
Mild	2	
Moderate	-	
Severe	3	
Hydrocephalus	2	10
Tumor	4	20
Brain	3	
Spine	1	

All neurosurgical patients who presented to MGH or were referred during this pandemic were screened and evaluated. Those with life-threatening emergencies were operated immediately; whereas urgent cases were triaged based on the complexity of the case, availability of surgical instruments, and the ability of anesthetic team to support. Urgent cases that could be handled with the current setup were operated according to a semi-emergency list. Patients were discharged as soon as possible postoperatively to generate the capacity to cope with more cases.

All patients who required emergency surgeries were screened for potential risk of contracting COVID-19. Patients with no known exposure to COVID-19 cases and those without acute respiratory signs and symptoms with a normal chest radiograph were considered low-risk. Low-risk patients were operated by one neurosurgeon and one medical officer with an N95 mask and face shield in addition to the standard surgical gown and attire. Auxiliary staff in the same theater put on a face shield on top of their 3-ply surgical mask. We did not encounter any high-risk

Table 2. Clinical Outcomes for the Cases Operated at Miri General Hospital During the Initial 6 Weeks of Movement Control Order in Malaysia

Outcome	Number	%
Good	7	38.9
Moderate disability	4	22.2
Severe disability	5	27.7
Vegetative	1	5.6
Death	1	5.6

Good: GOS 5/Frankel E; moderate disability: GOS 4/Frankel D; severe disability: GOS 3/Frankel A-C; vegetative state: GOS 2.
GOS, Glasgow Outcome Scale.

patients that necessitated the use of a higher level of personal protective equipment during that short period of time. COVID-19 polymerase chain reaction test was performed for patients requiring transfer and they were transferred after the test result became available to avoid the potential spread of this virus.

RESULTS

During the first 6 weeks of the Movement Control Order, 50 patients sought urgent consultations. Twenty patients (40%) required emergency surgery or intervention. There were 9 vascular (45%), 5 trauma (25%), 4 tumor (20%), and 2 hydrocephalus cases (10%) (Table 1).

Of the 8 patients with intracranial hemorrhage, there were 6 with basal ganglia bleed, 1 with lobar hemorrhage, and 1 with cerebellar hemorrhage and obstructive hydrocephalus. The 3 patients with severe head injury were diagnosed as having extradural hematoma in 2, and compound depressed skull fracture with underlying contusion in 1. As for those with mild head injury, 1 suffered from penetrating brain injury and another patient had an open scalp wound. The tumors operated here consisted of posterior fossa tumors with obstructive hydrocephalus in 2 patients, and a thoracic tumor with paraparesis in 1 patient. There were 2 patients with postinfectious hydrocephalus.

Eighteen (90%) out of the 20 patients who required surgery were operated on at MGH. Two patients (10%) with skull base tumor and a symptomatic dural arteriovenous fistula each required transfer due to the lack of supporting equipment and facilities. Of the 18 patients operated at MGH, 17 (94.4%) survived following prompt neurosurgical intervention, and 11 (61.1%) had satisfactory outcomes (Table 2). There was 1 death (5.6%) of a male patient with obstructive hydrocephalus secondary to cerebellar hemorrhage.

With this framework and strategy in place, 90% of the transfers were avoided during the pandemic, and none among the clinical staff involved in the care of the patient contracted COVID-19.

DISCUSSION

MGH is a remote center in Sarawak with difficult access to neurosurgical services due to its unique logistic and geographic challenges. The emergence of the COVID-19 pandemic has imposed an additional barrier to the transfer of patients with time-sensitive neurosurgical emergencies.

During this crisis, interdistrict movements were controlled, and the need for approval from multiple relevant authorities intensified the barrier restricting traveling. There were major reductions in air travel and schedules in accordance with the travel ban that resulted in very limited and inconsistent flight schedules. This posed significant challenges in the transfer process for patients. The alternative usage of air ambulance (MEDEVAC) was confounded by potential requests to airlift COVID-19 patients.

Movement in public places during transfer undeniably increases the exposure and risk of COVID-19 in both the patient and the escorting staff. Accommodation was also an issue because the existing center in the hospital had been converted into "wards" to cater for the treatment of COVID-19 patients. Many hotels either stopped operating or were turned into quarantine center for patients undergoing investigations. Some affected caretakers with

diminished income and reduced social support during this crisis and pandemic struggled to make ends meet while dealing with both physical and emotional stress.

An initiative for such contingencies had been planned before the pandemic to overcome logistic issues in neurosurgical emergencies that would result in loss of life or function without immediate treatment. The same was implemented, and it contributed significantly during this evolving crisis. With this framework in place, 94.4% of the patients with neurosurgical emergencies survived following surgery, and 90% of the transfers were avoided during the initial phase of COVID-19 pandemic in Malaysia. Outcomes during a pandemic would have been different without this existing framework in place.

A rotational schedule in the current framework helps reduce virus exposure and conserve team members for clinical care. Stationing neurosurgeons at different centers reserves the neurosurgical manpower in the state by allowing critical care to be carried on even if 1 center has to be locked down due to COVID-19. Besides operating on neurosurgical emergencies at MGH, neurosurgeons stationed here assisted in the evaluation and triage of neurosurgical cases, which reduced unnecessary transfers. Training in basic neurosurgical management, including post-operative care, was provided to supporting team members. Visits of other neurosurgeons for their clinics to MGH were cut down during this pandemic, with the in-house neurosurgeon attending to patients who arrive for their clinic visits.

The overall number of transfers was limited to the minimum, with only those with clear indications being transferred. This

significantly eased the receiving hospital's congestion and decreased ventilator occupancy while it was overwhelmed with COVID-19 referrals and admissions. Additionally, the cost incurred by our health care system due to the process of transfer could be cut down, and the need for medical escorts was reduced.

To ascertain the way forward in the midst of this pandemic, this framework requires constant refinement based on the evolving clinical information revealed about COVID-19. The existing surgical equipment and facilities need to be stepped-up or refurbished to accommodate a wider range of cases.

CONCLUSIONS

The COVID-19 pandemic has disrupted the delivery of care to neurosurgical patients globally. The setup of this framework allowed timely intervention for neurosurgical emergencies, minimized transfer, and enabled continuity of neurosurgical care at a remote center with difficult access to neurosurgical services during the pandemic.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Peh Hueh Low: Conceptualization, Methodology, Formal analysis, Resources, Writing - original draft, Writing - review & editing, Visualization. **Manvinder Singh Mangat:** Resources. **Donald Ngian San Liew:** Supervision. **Albert Sii Hieng Wong:** Supervision.

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