Original Article

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Impact of The COVID-19 Pandemic on Neurology: Report from A General Hospital in Tokyo

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Abstract:

Objective: The aim of this study was to investigate the impact of the coronavirus disease 2019 (COVID-19) pandemic on neurology in Japan, by analyzing data on the number of neurological patients at our hospital in Tokyo.

Material and Methods: We counted the number of inpatients and outpatients per month; from January 2018 to September 2020. We defined the data from April 2020 to May 2020, as the first wave of the COVID-19 pandemic, and that from July 2020 to September 2020, as the second wave. The data from each wave were compared to those in the same period within the previous 2 years. We also analyzed other data; including, inpatients with stroke, outpatients with Parkinson's disease, and outpatients with epilepsy.

Results: In the first wave, the overall number of inpatients and outpatients greatly decreased; however, the number of inpatients with stroke increased. The ratio of outpatients with Parkinson's disease, or outpatients with epilepsy to total outpatients also increased. In the second wave, the overall number of inpatients markedly increased, while that of outpatients slightly decreased.

Conclusion: All Japanese general hospitals were greatly affected by the COVID-19 pandemic; especially in the first wave, even if the hospitals did not have in-hospital COVID-19 infection, or were not designated for COVID-19. Three factors; i.e. governmental, hospital, and patient factors, could affect the number of neurological patients during the COVID-19 pandemic. The numerical data reflecting the patients' behavior might provide suggestions for addressing issues during other pandemics in the future.

Keywords: COVID-19, epilepsy, neurology, Parkinson's disease, stroke

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Introduction

Coronavirus disease 2019 (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), first emerged in Wuhan, China.[1] It then rapidly spread to most countries throughout the world, causing the COVID-19 pandemic. In Japan, the first COVID-19 patient was identified on January 15, 2020, then by September 30, 2020, there were 79,000 COVID-19 patients in Japan; with over 25,000 in Tokyo alone: as shown in Figure 1 (the data were obtained from the Ministry of Health, Labour and Welfare and the Tokyo Metropolitan Government websites).[2,3] COVID-19 patients in Tokyo comprised of approximately 31% of those in Japan. Currently, there have been two peaks in the COVID-19 pandemic, which have commonly been called the first wave and second wave. Although there seemed to be fewer COVID-19 patients in the first wave than in the second wave, the number of COVID-19 patients from the first wave is not accurate; because of the Japanese governments policy that restricted testing to only severe patients.[4,5] Addtionally, the polymerase chain reaction (PCR) test to confirm COVID-19 was performed mainly by local public health centers during the first wave. However, university hospitals, general hospitals, and clinics in addition to the local public health centers were able to perform this test during the second wave. In contrast to the time course of the first wave, the numbers in the second wave are considered to be reliable. As shown in Figure 1, the time course in Tokyo is almost the same as that in Japan. Clusters of COVID-19 patients were frequently identified in Tokyo. Therefore, Tokyo is considered to be a representative city for the COVID-19 pandemic in Japan.

The COVID-19 pandemic disrupted social activities, including medical services throughout the world. In Japan, to prevent the spread of COVID-19, a state of emergency was declared by the government on April 7, 2020, which was then lifted on May 25, 2020. Although the state of emergency was a request-based, insufficient lockdown, Japan made it through the first wave of COVID-19 in relatively better shape than some other countries.[5,6] The government also approved medical service prescriptions via telephone in April 2020; thus, patients have been able to obtain their drugs via telephone, without having to visit hospitals or clinics.

There have been several papers on the impact of the COVID-19 pandemic on neurology throughout the world.[7-9] The incidence of specific neurological diseases that might be related to the COVID-19 infection; for example, stroke, Guillain–Barré syndrome and other polyneuropathy; including facial palsy, are notable.[9,10] However, the impact of the COVID-19 pandemic on neurology in Japan has not been sufficiently reported. For example; there are few reports on the behavior of neurological patients during the COVID-19 pandemic. To address these issues, we analyzed the number of neurological patients at our hospital, because this numerical data must reflect the patients' behavior. Additionaly, such knowledge regarding patient behaviors might be valuable in helping to address issues during other pandemics in the future.

Our hospital, which is a medium-sized general hospital, is located in the center of Tokyo, and it is surrounded by many other hospitals; ranging from large university hospitals to small clinics. Hospitalization of COVID-19 patients in Tokyo was initially limited to only designated hospitals; such, as medical institutions that were designated for specified infectious diseases in addition to Tokyo metropolitan hospitals belonging to Tokyo Metropolitan Health and Hospitals Corporation.[2] Although our hospital was not designated for COVID-19, nine patients with COVID-19, confirmed by a positive PCR test results, were hospitalized here for treatment; as of September 30, 2020. Although our hospital was free from in-hospital COVID-19 infection in the first wave, several hospitals nearby had in-hospital COVID-19 infection, and some

hospitals temporally stopped seeing patients due to these in-hospital COVID-19 infections. Therefore, the data at our hospital would differ from those of the other hospitals that had in-hospital COVID-19 infections, and from hospitals that were designated for COVID-19 patients. In this paper, we analyzed the number of neurological patients at our hospital, and we speculated regarding the impact of the COVID-19 pandemic on neurology at Japanese general hospitals without in-hospital COVID-19 infections, or that were designated for COVID-19. We also speculated on the patients' behavior during the COVID-19 pandemic.

Material and Methods

We included cumulative data on the total number of inpatients and outpatients in the Department of Neurology; including, the outpatients who used telephone prescriptions, per month from January 1, 2018 to September 30, 2020. We defined the data from April 1, 2020 to May 31, 2020, as the first wave of the COVID-19 pandemic, and that from July 1, 2020 to September 30, 2020 as the second wave; based on the number of patients in Tokyo (Figure 1). The data in each wave were compared to the average data in the same period from the previous 2 years 2018 and 2019. We also counted the total number of inpatients and outpatients at our hospital, and we calculated the ratio of the total number of inpatients in the Department of Neurology to the total number of inpatients at our hospital; and the ratio of the total number of outpatients in the Department of Neurology to the total number of outpatients at our hospital. We also analyzed other cumulative data from patients in the Department of Neurology, as follows: inpatients with ischemic stroke [atherothrombotic, lacunar, cardioembolic, transient ischemic attack (TIA), and others], inpatients with hemorrhagic stroke (only cerebral hemorrhage), outpatients with Parkinson's disease, and outpatients with epilepsy. Based on these data, we calculated the ratio of each disease, as follows: the ratio of inpatients with ischemic stroke to the total number of inpatients, the ratio of inpatients with hemorrhagic stroke to the total number of inpatients, the ratio of outpatients with Parkinson's disease to the total number of outpatients, and the ratio of outpatients with epilepsy to the total number of outpatients. We selected

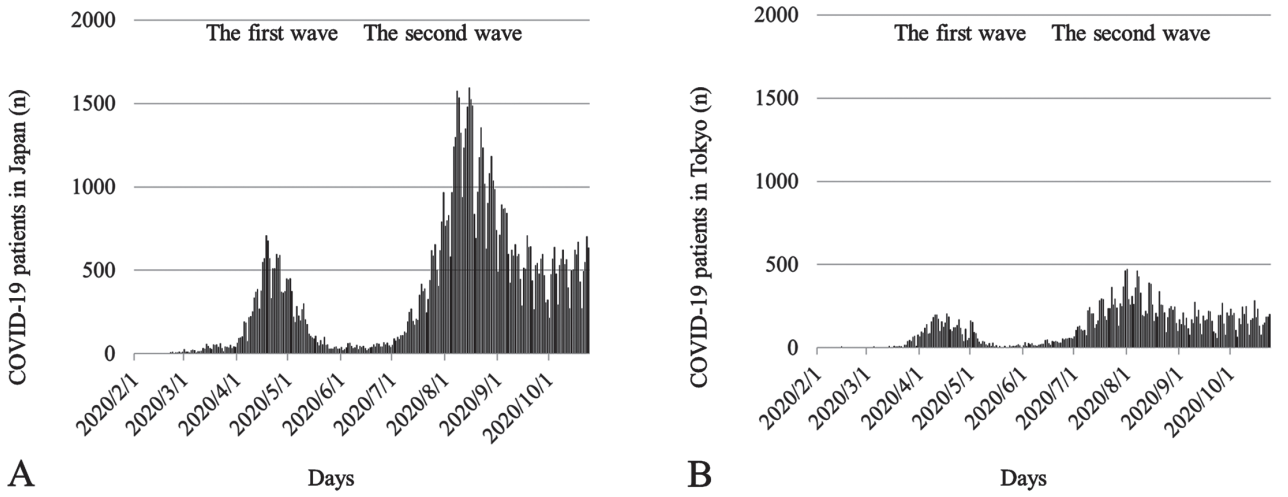

Figure 1 COVID-19 patients in Japan and Tokyo
(A) Japan (B) Tokyo

these data because stroke is the most common disease in inpatients, and Parkinson's disease and epilepsy are the most common diseases in outpatients.

The protocol in the present study was approved by the Ethics Committee at our hospital (IRB approval code: No. 52). The investigations were conducted in accordance with the ethical standards of the Declaration of Helsinki.

Results

The results are summarized in Table 1.

Inpatients and outpatients at our hospital

Figure 2 shows the total number of inpatients, and the total number of outpatients at our hospital. In the first wave, there were 1,570 inpatients, and in the same period over the past 2 years (from the average data of April to May in 2018 and 2019), there were 2,117 inpatients, which indicated a decrease of 25.8%. In the second wave, there were 3,161 inpatients, and in the same period during the previous 2 years (average data from July to September in 2018 and 2019), there were 3,221.5 inpatients: which showed an unremarkable change.

In the first wave, there were 34,243 outpatients, and in the same period from the previous 2 years, while there were 47,078.5 outpatients, indicating a decrease of 27.3%. In the second wave, there were 64,069 outpatients, and in the same period from the previous 2 years, there were 70,199 outpatients; indicating a decrease of 8.7%.

In summary, in the first wave, the total number of inpatients and outpatients at our hospital greatly decreased. However, in the second wave, the total number of inpatients was almost equal to that of the previous 2 years; while the number of outpatients slightly decreased.

Inpatients and outpatients in the Department of Neurology

Figure 3 shows the total number of inpatients, and the total number of outpatients in the Department of Neurology. In the first wave, there were 41 inpatients, and in the same period recorded from the previous 2 years, there were 50 inpatients; indicating a decrease of 18.0%. The ratio of the total number of inpatients in the Department of Neurology to the total number of inpatients at our hospital in the first wave was 0.026, and that in the same period

Table 1 Study results

Number of patients	The first wave in 2020	The past 2 years (average)	Change (%)	The second wave in 2020	The past 2 years (average)	Change (%)
Total inpatients, Hospital (n)	1570	2,117.0	25.8 ↓	3161	3221.5	1.9 ↓
Total inpatients, Neurology (n)	41	50.0	18.0 ↓	111	80.5	37.9 ↑
Ratio of Neurology	0.026	0.024	8.3 ↑	0.035	0.025	40.0 ↑
Ischemic stroke (n)	24	21.0	14.3 ↑	52	39.0	33.3 ↑
Ratio of ischemic stroke	0.589	0.418	40.9 ↑	0.468	0.482	2.9 ↓
Hemorrhagic stroke (n)	5	1.5	233.3 ↑	10	5.5	90.9 ↑
Ratio of hemorrhagic stroke	0.122	0.071	71.8 ↑	0.090	0.068	32.4 ↑
Total outpatients, Hospital (n)	34,243	47,078.5	27.3 ↓	64,069	70,199.0	8.7 ↓
Total outpatients, Neurology (n)	676	988.0	31.6 ↓	1,296	1,429.5	9.3 ↓
Ratio of Neurology	0.020	0.021	4.8 ↓	0.020	0.020	0.0
Parkinson's disease (n)	126	140.0	10.0 ↓	199	212.5	6.4 ↓
Ratio of Parkinson's disease	0.186	0.142	31.0 ↑	0.154	0.149	3.4 ↑
Epilepsy (n)	71	83.5	15.0 ↓	108	123.0	12.2 ↓
Ratio of epilepsy	0.105	0.085	23.5 ↑	0.084	0.086	2.3 ↓

from the previous 2 years was 0.024; indicating an increase of 8.3%. In the second wave, there were 111 inpatients, and in the same period over the previous 2 years, there were 80.5 inpatients; indicating an increase of 37.9%. The ratio of the total number of inpatients in the Department of Neurology to the total number of inpatients at our hospital in the second wave was 0.035, and that in the same period over the previous 2 years was 0.025; indicating an increase of 40.0%.

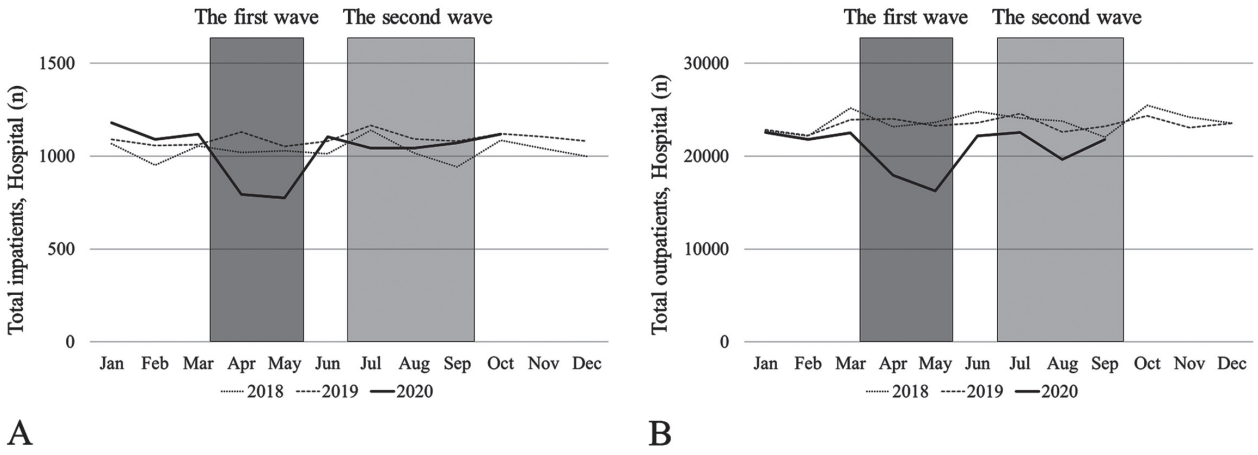

Figure 2 Inpatients and outpatients at our hospital.
(A) The total number of inpatients. (B) The total number of outpatients.

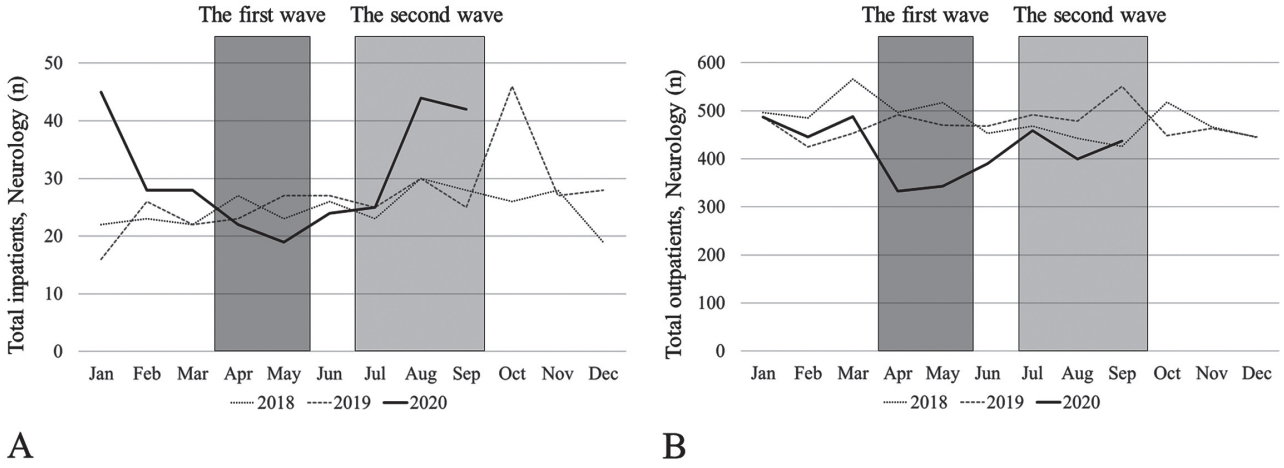

Figure 3 Inpatients and outpatients in the Department of Neurology.
(A) The total number of inpatients. (B) The total number of outpatients.

In the first wave, there were 676 outpatients, and in the same period from the previous 2 years there were 988 outpatients; indicating a decrease of 31.6%. In the first wave, there were 79 outpatients who used telephone prescriptions, which was 11.7% of the total number of outpatients. The ratio of the total number of outpatients in the Department of Neurology to the total number of outpatients at our hospital in the first wave was 0.020, and that in the same period recorded from the previous 2 years was 0.021; indicating an unremarkable change. In the second wave, there were 1,296 outpatients, and in the same period from the previous 2 years there were 1,429.5 outpatients; indicating a decrease of 9.3%. In the second wave, there were 38 outpatients who used telephone prescriptions, which was 2.9% of the total number of outpatients. The ratio of the total number of outpatients in the Department of Neurology to the total number of outpatients at our hospital in the second wave was 0.020, and that in the same period from the previous 2 years was 0.020; indicating an unremarkable change.

In summary, in the first wave, the total number of inpatients in the Department of Neurology greatly decreased, but the ratio of inpatients in the Department of Neurology to the total number of inpatients at our hospital slightly increased. Additionally, the total number of outpatients in the Department of Neurology greatly decreased, and the ratio of outpatients in the Department of Neurology to the total number of outpatients at our hospital was almost equal to that during the previous 2 years. In the second wave, the total number of inpatients markedly increased, and the ratio of inpatients in the Department of Neurology to the total number of inpatients at our hospital also markedly increased. Addtionally, that of outpatients slightly decreased and the ratio of outpatients to the total number of outpatients at our hospital was almost equal to that during the previous 2 years. These results suggest that the number of inpatients in the Department of Neurology relatively increased compared to the total number of inpatients at our hospital.

Ischemic stroke

Figure 4 shows the number of inpatients with ischemic stroke, and the ratio of inpatients with ischemic stroke to the total number of inpatients in the Department

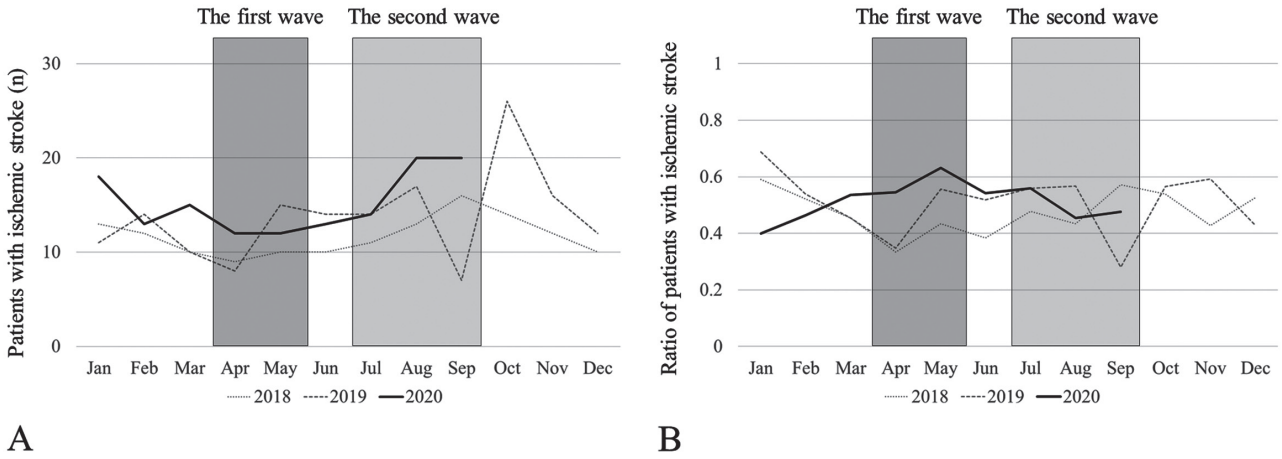

Figure 4 Ischemic stroke

(A) Inpatients with ischemic stroke. (B) The ratio of inpatients with ischemic stroke to the total number of inpatients in the Department of Neurology.

of Neurology. In the first wave, there were 24 inpatients with ischemic stroke and in the same period during the previous 2 years there were 21 inpatients with ischemic stroke; indicating an increase of 14.3%. The ratio of inpatients with ischemic stroke to the total number of inpatients in the first wave was 0.589, and that in the same period over the previous 2 years was 0.418; indicating an increase of 40.9%. In the second wave, there were 52 inpatients with ischemic stroke, and in the same period over the previous 2 years there were 39 inpatients with ischemic stroke; indicating an increase of 33.3%. The ratio of inpatients with ischemic stroke to the total number of inpatients in the first wave was 0.468, and that in the same period from the previous 2 years was 0.482; indicating an unremarkable change.

Figure 5 shows the classification of ischemic stroke. In the first wave, cardioembolic stroke and TIA increased and atherothrombotic stroke decreased compared to the previous 2 years. In the second wave, lacunar infarction was reduced.

In summary, in the first and second waves, the number of inpatients with ischemic stroke increased. The ratio of inpatients with ischemic stroke to the total number of

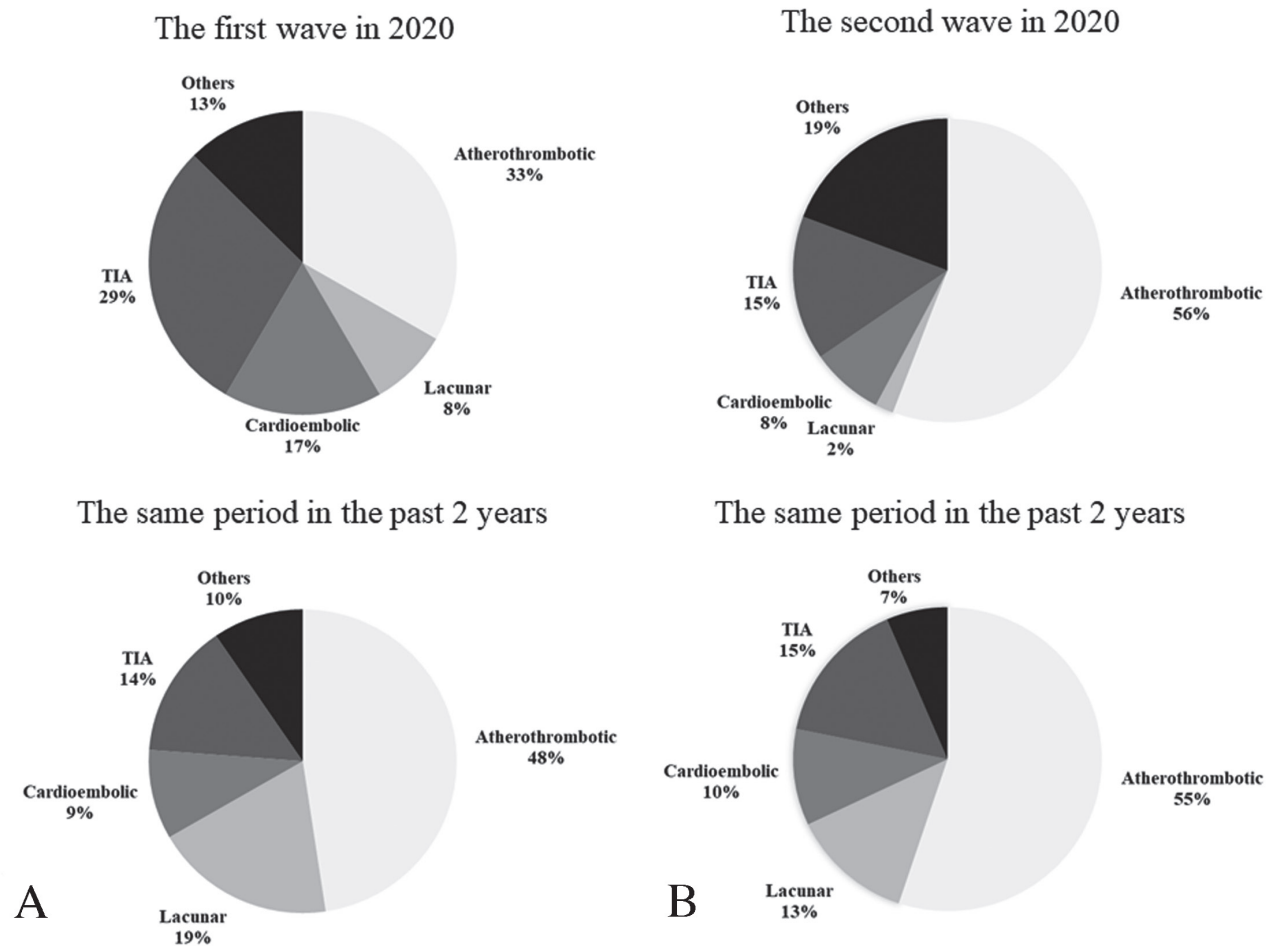

Figure 5 Classification of ischemic stroke
(A) The first wave. (B) The second wave.

inpatients also increased. Among them, emergent inpatients with cardioembolic stroke and TIA greatly increased. In the second wave, the ratio of inpatients with ischemic stroke to the total number of inpatients was almost equal to that of the previous 2 years. These results suggest that in the first wave, the relative increase in inpatients with ischemic stroke contributed to the total number of inpatients in the Department of Neurology.

Hemorrhagic stroke

The number of inpatients with hemorrhagic stroke was considerably smaller than that of inpatients with ischemic stroke. In the first wave, there were five inpatients with hemorrhagic stroke, and in the same period within the past 2 years, there were 1.5 patients with hemorrhagic stroke, indicating an increase of 233.3%. The ratio of inpatients with hemorrhagic stroke to the total number of inpatients in the Department of Neurology in the first wave was 0.122, and that in the same period over the past 2 years was 0.071, indicating an increase of 71.8%. In the second wave, there were ten inpatients with hemorrhagic stroke, and in the same period within the past 2 years, there were 5.5 patients with hemorrhagic stroke, indicating an increase of 90.9%. The ratio of inpatients with hemorrhagic stroke to the total number of inpatients was 0.090 and that in the same period within the past 2 years was 0.068, indicating an increase of 32.4%.

In summary, in the first and second waves, the number of inpatients with hemorrhagic stroke increased, and the ratio of inpatients with hemorrhagic stroke to the total number of inpatients also increased. Although, caution should be used to interpret the results; due to the small number of inpatients with hemorrhagic stroke, these results indicate that the number of inpatients with stroke increased regardless of the type of stroke; i.e. ischemic stroke or hemorrhagic stroke.

Parkinson's disease

Figure 6 shows the number of outpatients with Parkinson's disease, and the ratio of outpatients with Parkinson's disease to the total number of outpatients in the Department of Neurology. In the first wave, there were

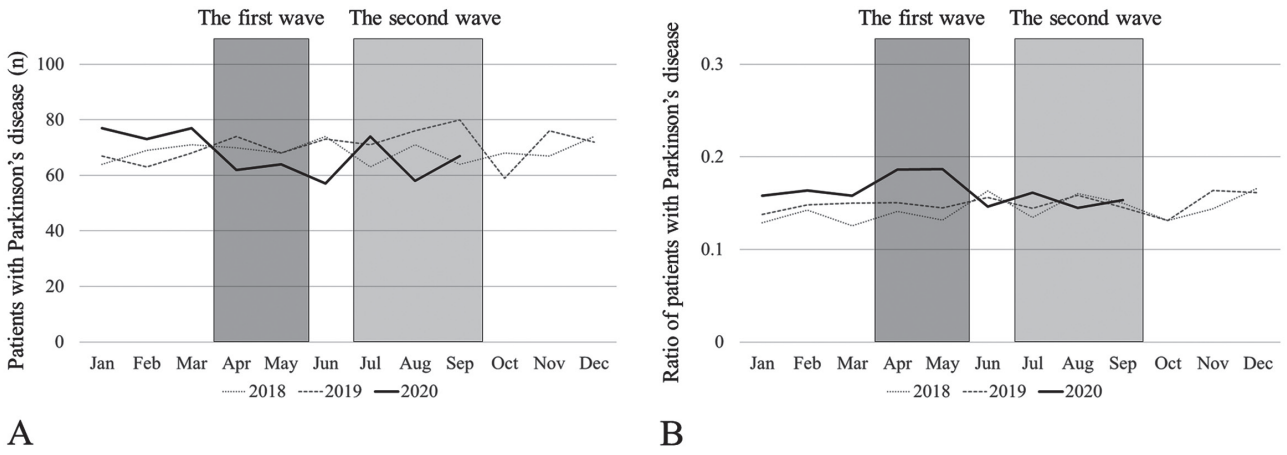

Figure 6 Parkinson's disease

(A) Outpatients with Parkinson's disease. (B) The ratio of outpatients with Parkinson's disease to the total number of outpatients in the Department of Neurology.

126 outpatients with Parkinson's disease, and in the same period over the past 2 years, there were 140 patients with Parkinson's disease, indicating a decrease of 10.0%. The ratio of outpatients with Parkinson's disease to the total number of outpatients in the first wave was 0.186 and that in the same period from the past 2 years was 0.142, indicating an increase of 31.0%. In the second wave, there were 199 outpatients with Parkinson's disease, and in the same period over the past 2 years, there were 215.5 patients with Parkinson's disease, indicating a decrease of 6.4%. The ratio of outpatients with Parkinson's disease to the total number of outpatients in the second wave was 0.154, and that in the same period from the past 2 years was 0.149, indicating an unremarkable change.

In summary, in the first and second waves, the number of outpatients with Parkinson's disease decreased. In the first wave, however, the ratio of outpatients with Parkinson's disease to the total number of outpatients increased. In the second wave, the ratio of outpatients with Parkinson's disease to the total number of outpatients was almost equal to that of the past 2 years.

Epilepsy

Figure 7 shows the number of outpatients with epilepsy and the ratio of outpatients with epilepsy to the total number of outpatients in the Department of Neurology. In the first wave, there were 71 outpatients with epilepsy, and in the same period from the previous 2 years, there were 83.5 patients with epilepsy, indicating a decrease of 15.0% in the first wave. The ratio of outpatients with epilepsy to the total number of outpatients was 0.105 in the first wave, and to that in the same period over the past 2 years was 0.085, indicating an increase of 23.5%. In the second wave, there were 108 outpatients with epilepsy, and in the same period within the past 2 years, there were 123.0 patients with epilepsy, indicating a decrease of 12.2%. The ratio of outpatients with epilepsy to the total number of outpatients in the second wave was 0.084 and that of the same period in the previous 2 years was 0.086, which indicates an unremarkable change.

In summary, in the first and second waves, the number of outpatients with epilepsy decreased. In the first wave, however, the ratio of outpatients with epilepsy to the

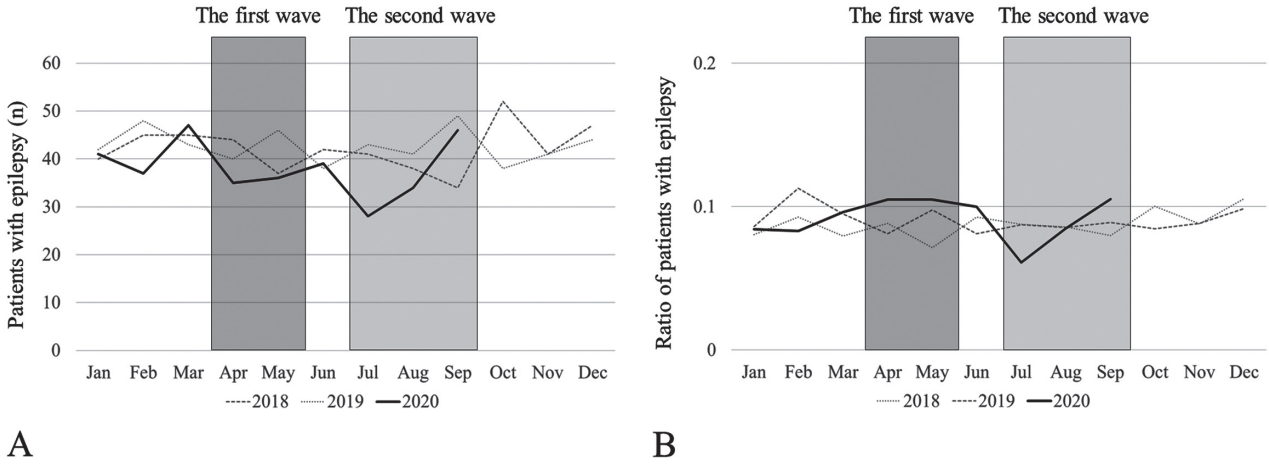

Figure 7 Epilepsy

(A) Outpatients with epilepsy. (B) The ratio of outpatients with epilepsy to the total number of outpatients in the Department of Neurology.

total number of outpatients increased. In the second wave, the ratio of outpatients with epilepsy to the total number of outpatients was almost equal to that of the past 2 years.

Discussion

In this study, the data on the number of neurological patients showed several results. In the first wave, the overall number of inpatients in the Department of Neurology severely decreased compared with that of the previous 2 years; however, the number of inpatients with stroke increased. The total number of outpatients also greatly decreased compared with the previous 2 years, but the ratio of outpatients with Parkinson's disease or outpatients with epilepsy to the total number of outpatients increased. In the second wave, the total number of inpatients markedly increased, and the ratio of inpatients with ischemic stroke to the total number of inpatients was almost equal to that of the past 2 years. The total number of outpatients slightly decreased, and the ratio of outpatients with Parkinson's disease or epilepsy to the total number of outpatients was almost equal to that of the past 2 years. Thus, the impact of the first wave of COVID-19 on neurology at our hospital was stronger than that of the second wave.

The first wave in the COVID-19 pandemic

As shown in the present study, the total number of inpatients and outpatients in the Department of Neurology greatly decreased. We proposed that three factors were involved in the decrease in the patient numbers: government factors, hospital factors, and patient factors.

First, the government declared a state of emergency during the first wave.[5,6] During this state of emergency, citizens were requested to stay home and refrain from going out; except for emergencies. Therefore, if patients did not have an emergency, they might postpone visiting a hospital.

Next, hospitals refrained from non-urgent hospitalization or unnecessary outpatient services.[11] Non-emergency surgery and radiotherapy were postponed.[12] During the state of emergency, the supply of standard gowns or aprons, surgical masks, goggles, and face shields in addition to personal protective equipment was insufficient in most hospitals.[13,14] In addition, the PCR test was not available at most hospitals.[15] Therefore, to avoid in-hospital COVID-19 infection, due to insufficient protective medical resources, hospitals might have restricted medical services.

Finally, patients might have avoided visiting hospitals. A study using questionnaires showed that most patients felt anxiety toward COVID-19, as follows: anxiety about COVID-19 knowledge; anxiety about being infected; anxiety about infecting someone; anxiety about the disease severity when infected; and anxiety about the virus' spread.[16] Therefore, patients might postpone visiting hospitals, because of these anxieties; especially anxiety about being infected.

The overall number of inpatients decreased, whereas the number of inpatients with stroke increased. This could be explained in that our hospital provided assistance for other hospitals that were medically disrupted by in-hospital COVID-19 infection; several hospitals around our hospital had in-hospital COVID-19 infection, and some hospitals temporarily stopped seeing patients because of in-hospital infection.[17] A study using questionnaires revealed that 13 out of 38 hospitals in Tokyo had in-hospital COVID-19 infection, which was 34.0% of the hospitals in the study.[18] Because stroke is an emergent disease, patients with stroke would be transferred to our hospital instead of the hospitals with in-hospital COVID-19 infection. For other pandemics in the future, emergent networks among hospitals might be required.

However, there were comparatively more outpatients with Parkinson's disease or epilepsy than outpatients with other diseases. This could be due to anti-parkinsonian drugs are required to treat patients with Parkinson's disease. Similarly, anti-epileptic drugs are also required for patients with epilepsy. Therefore, even during the state

of emergency, these patients might have needed to visit or phone our hospital to obtain these drugs. For other pandemics in the future, telemedicine might be required.

The second wave in the COVID-19 pandemic

In the second wave, the number of inpatients in the Department of Neurology markedly increased, while that of outpatients slightly decreased. This is likely because of improvements to government factors, hospital factors, and patient factors. As the governments did not declare a state of emergency during the second wave, hospitals resumed accepting patients for all types of hospitalization and outpatient services. The medical staff also had knowledge about COVID-19 prevention, and they had sufficient protective medical resources; such as, standard gowns or aprons, surgical masks, goggles, face shields, and personal protective equipment.[13,14] The PCR test also became available at more hospitals.[2,15] Additionally, patients did not avoid visiting hospitals. Patients had some knowledge about COVID-19 prevention; such as, frequent handwashing, wearing surgical masks, social distancing, and avoiding the overlapping three Cs (closed spaces with poor ventilation; crowded places with many people nearby; and close-contact settings, such as close-range conversations). This was a governmental campaign, and this was a unique and useful message against COVID-19 in Japan.[19]

Conclusion

Tokyo is considered to be a representative city for the COVID-19 pandemic in Japan. Therefore, we speculate that our data might be representative data that describes the impact of the COVID-19 pandemic on neurology in Japanese general hospitals that had no in-hospital COVID-19 infection or that were not a designated COVID-19 hospital. All Japanese general hospitals were severely affected by the COVID-19 pandemic; especially in the first wave, even if the hospitals did not have in-hospital COVID-19 infection or they were not designated for COVID-19. Three factors; i.e. government factors, hospital factors, and patient factors, could have affected the number of neurological patients during the COVID-19 pandemic. The numerical data reflecting patient behaviors might provide suggestions for dealing with issues during other pandemics in the future. For example, emergent networks among hospitals and telemedicine might be required in addition to a rapid and strong lockdown, sufficient protective medical resources, available PCR tests, and adequate knowledge about prevention for an infectious disease.

Funding sources

None

Conflict of interest

None

References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.
2. Novel Coronavirus (COVID-19) [homepage on Internet]. Ministry of Health, Labour and Welfare [cited 2020 Oct 1]. Available from: https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000164708_00079.html
3. Latest updates on COVID-19 in TOKYO [homepage on Internet]. Tokyo Metropolitan Government [cited 2020 Oct 1]. Available from: https://stopcovid19.metro.tokyo.lg.jp/en
4. Hoshina T, Aonuma H, Ote M, Sakurai T, Saiki E, Kinjo Y, et al. Intensive diagnostic management of coronavirus disease 2019 (COVID-19) in academic settings in Japan: challenge and future. Inflamm Regen 2020;40:38.
5. Kuniya T. Evaluation of the effect of the state of emergency for the first wave of COVID-19 in Japan. Infect Dis Model 2020; 5:580-7.
6. Sugaya N, Yamamoto T, Suzuki N, Uchiumi C. A real-time survey on the psychological impact of mild lockdown for COVID-19 in the Japanese population. Sci Data 2020;7:372.
7. Román GC, Spencer PS, Reis J, Buguet A, Faris MEA, Katrak

SM, et al. The neurology of COVID-19 revisited: a proposal from the Environmental Neurology Specialty Group of the World Federation of Neurology to implement international neurological registries. J Neurol Sci 2020;414:116884.

8. Paterson RW, Brown RL, Benjamin L, Nortley R, Wiethoff S, Bharucha T, et al. The emerging spectrum of COVID-19 neurology: clinical, radiological and laboratory findings. Brain 2020;143:3104-20.
9. Ellul MA, Benjamin L, Singh B, Lant S, Michael BD, Easton A, et al. Neurological associations of COVID-19. Lancet Neurol 2020;19:767-83.
10. Codeluppi L, Venturelli F, Rossi J, Fasano A, Toschi G, Pacillo F, et al. Facial palsy during the COVID-19 pandemic. Brain Behav 2021;11:e01939.
11. Komatsu H, Banno K, Yanaihara N, Kimura T; Board Members of Japan Society of Obstetrics and Gynecology. Prevention and practice during the COVID-19 emergency declaration period in Japanese obstetrical/gynecological facilities. J Obstet Gynaecol Res 2020;46:2237-41.
12. Murakami N, Igaki H, Okamoto H, Kashihara T, Kaneda T, Takahashi K, et al. Preparation for the COVID-19 pandemic in the department of radiation oncology in the National Cancer Center Hospital in Tokyo. J Radiat Res 2020;61:635-7.
13. Umazume T, Miyagi E, Haruyama Y, Kobashi G, Saito S, Hayakawa S, et al. Survey on the use of personal protective equipment and COVID-19 testing of pregnant women in Japan. J Obstet Gynaecol Res 2020;46:1933-9.
14. Mitsuboshi S, Yoshino M, Hosokawa H, Isobe H, Kobayashi K. Use of personal protective equipment while admixing antineoplastic drugs during the COVID-19 pandemic era: questionnaire survey in Niigata, Japan. J Oncol Pharm Pract 2020;26:1553-4.
15. Ota I, Asada Y. The impact of preoperative screening system on head and neck cancer surgery during the COVID-19 pandemic: recommendations from the nationwide survey in Japan. Auris Nasus Larynx 2020;47:687-91.
16. Shiina A, Niitsu T, Kobori O, Idemoto K, Hashimoto T, Sasaki T, et al. Relationship between perception and anxiety about COVID-19 infection and risk behaviors for spreading infection: a national survey in Japan. Brain Behav Immun Health 2020;6:100101.
17. Uchida T, Takagi Y, Mizuno A, Okamura H, Saito H, Ide S, et al. Retrospective analysis of nosocomial COVID-19: a comparison between patients with hematological disorders and other diseases. Rinsho Ketsueki 2020;61:857-64.
18. Tagashira Y, Takamatsu A, Hasegawa S, Uenoyama Y, Honda H. A survey of preparedness against coronavirus disease 2019 (COVID-19) in hospitals in Tokyo, Japan, with healthcare personnel with COVID-19 and in-facility transmission. Infect Control Hosp Epidemiol 2021;42:746-50.
19. Muto K, Yamamoto I, Nagasu M, Tanaka M, Wada K. Japanese citizens' behavioral changes and preparedness against COVID-19: an online survey during the early phase of the pandemic. PLoS One 2020;15:e0234292.