

The effect of the COVID-19 outbreak on intensive care in northern Saitama, Japan

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ABSTRACT

Background : The 2020 COVID-19 pandemic had various effects on local healthcare. The aim of this study was to assess the extent to which local healthcare and healthcare workers were affected by the COVID-19 pandemic.

Methods : In this observational study we examined and compared intensive care units (ICUs) before (2019) and during (2020) the COVID-19 pandemic to assess its effects. Emergency patient data were obtained from the Saitama Prefecture Emergency Medical Information System. The effect of COVID-19 on emergency care responses was compared with the admission and refusal of patients in 2019 and 2020. We also examined the number of patients who were admitted to ICUs and required surgery. The effect on ICUs was examined with the number of Nurses' incident reports and severity percentages calculated from the integrated team medical care and safety system. We also compared the overtime hours of physicians on the basis of employment records.

Results : In 2019, 2,136 emergency requests were made to admit patients, and 1,811 patients (85%) were admitted. In contrast, in 2020, 2,371 emergency requests were made, and 1,822 patients (76%) were admitted, representing a decrease to 76% ($p = 0.931$). The percentage of patients for whom admission was refused was significantly greater in 2020 (506 patients, 21.3%) than in 2019 (303 patients, 14.1% ; $p = 0.0004$). In 2020, the number of neurosurgical, cardiac, and vascular operations increased and, over time, the number of operations increased for all surgical units. The number of incidents reported in ICUs increased significantly from 396 in 2019 to 510 in 2020 ($p = 0.001$).

Conclusion : Although intensive care management was restricted, the numbers of patients and physician overtime hours were greater during the COVID-19 pandemic than before, and the resulting environment led to an increase in the number of incidents. The ICU environments must be proactively improved to prepare for more severe situations in the future.

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Key words : COVID-19, intensive care, incident report, emergency patients, overtime work

INTRODUCTION

The number of patients with new coronavirus infections has increased, leading to a prominent reduction in the

number of hospital admissions for stroke, myocardial infarction, heart failure, or chronic obstructive pulmonary disease¹.

Throughout Japan, this reduction of admissions has

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been referred to as the “healthcare shortage,” but to what extent it is currently being addressed is unknown and statistical data on the effects of the virus in local areas is not currently available. We undertook this research because the acceptance of emergency patients was no longer decided on the basis of the department’s capacity as it had been before the COVID-19 pandemic. Against this background, we investigated the effect of COVID-19 on the intensive and emergency care of patients in departments of surgery (mainly cardiac surgery, vascular surgery, neurosurgery, and respiratory surgery) in 2020. In the Saitama Cardiovascular and Respiratory Center, we have dedicated personnel and a department for treating patients who have COVID-19, and our emergency medical care system gives priority to admitting these patients. The admission to the emergency system of patients who do not have COVID-19 depends on the occupancy of beds for patients who have COVID-19.

The respiratory disease intensive care unit (RCU) plays an important role in treating patients who have severe COVID-19 infections, and patients requiring intensive care after an operation are most often treated in the intensive care unit (ICU). The RCU nurses are chiefly responsible for the care of patients who have COVID-19 but are supported by ICU nurses during labor shortages.

Beds in the RCU have not always been fully occupied by patients with COVID-19 as a result of the ongoing emergency declarations from the government throughout 2020. The number of nurses needed has varied according to COVID-19 infection rates and the status of ICU support nurses has also fluctuated.

The number of ICU beds depends on the number of nurses supporting the RCU and currently fluctuates from 4 to 10 beds. Because the number of beds available for intensive care fluctuates during COVID-19, the effect of bed control on the prognosis of patients is significant, and the emergency system for patients without COVID-19 is inevitably limited, which contributes to a tightening of regional medical care.

Due to the COVID-19 pandemic the stress on nurses is extremely high, and the workload of ICU nurses has increased and affected their usual way of providing care. A study by Fernández-Castillo et al assessing the effect on nurses states found a high-quality training system is needed because of the lack of humanistic nursing care². The effect on nurses during the COVID-19 pandemic was also ex-

amined at the incident level.

MATERIAL AND METHODS

Study Design

This study was approved by the Institutional Review Board of the Saitama Cardiovascular and Respiratory Center (No. 2021013) as an observational study. Written informed consent to use the data for academic publication purposes was obtained from surgically treated patients, and opt-out information was provided on the hospital website and posted in the hospital.

Located in the northern part of Saitama Prefecture in Japan, our hospital can provide emergency medical care to approximately 600,000 people, including those in the surrounding area. Apart from our hospital, there are 3 core hospitals in the surrounding area that are smaller. We are the only hospital in northern Saitama that provides emergency care and surgery in the fields of cardiovascular and respiratory medicine. For this reason, our hospital attracts many patients who have been infected with COVID-19.

The total number of beds in our hospital is 343, with 12 ICU beds and 10 RCU beds. Patients who have COVID-19 are most often treated by the respiratory medicine department, but when staffing is insufficient, other departments provide back-up.

In this study, we examined the effect of COVID-19 on the intensive care system by comparing 2019 (before the pandemic) with 2020 (during the pandemic). In the field of emergency medicine, we compared the effect of COVID-19 on emergency responses in terms of the number of requests for emergency patient admissions, the actual number of admissions, and the admission refusal rate in 2019 and 2020. We also examined the number of operations performed by surgical departments and the number of patients requiring ICU admission. In addition, we compared the number of overtime hours of physicians engaged in intensive care from each department.

The effect on intensive care, including that provided in the ICU, under the support system of nurses was examined in terms of the total number of incident reports and the severity percentage calculated from the integrated team medical care and safety computer system (Safe Master[®], Safe Master Inc., Fukuoka, Japan). The incident levels followed the categories developed by Safe Master[®] (Table 1).

Table 1. Incident levels*

Incident Level	Description
0	
0.01	Even if it had been implemented, the impact upon patients would have been small
0.02	If implemented, the impact upon patients would be considered moderate (requiring treatment).
0.03	If implemented, the effects on the body would be significant (potentially life-threatening).
1	Conducted, but no real harm to patients (some effects cannot be ruled out)
2	No treatment or therapy was given (the need for increased patient observation, minor changes in vital signs, and safety checks arose).
3a	Required simple procedures and treatments (disinfecting, compressing, suturing skin, administering pain-killers, etc.)
3b	Required intensive treatment or therapy (e.g., severe change in vital signs, placement on a ventilator surgery, extended hospital stay, outpatient admission, fracture)
4a	Permanent disability and sequelae, with no significant functional impairment or cosmetic problems
4b	Death (excluding death due to the natural course of the primary disease)
5	Effect on the patient cannot be determined

Data Collection

Emergency patient data were managed by the Saitama Prefecture Emergency Medical Information System. The incident level data were calculated with Safe Master[®]. The number of operations was collected from hospital surgical records, and the number of overtime hours was collected from staff employment records.

Statistical Analysis

All data were analyzed with the software program IBM SPSS Statistics for Windows (version 26.0; IBM Corp., Armonk, NY, USA). Continuous variables are presented as means. The normality of all variables was assessed with the Shapiro-Wilk test. A nonpaired *t*-test, the χ^2 test, or Fisher's exact test was used to compare 2019 and 2020. Statistical significance was defined as a probability value of $p < .05$.

RESULTS

The total number of emergency patients, actual admissions, and refusals of admission in 2019 and 2020 are shown in Table 2. In 2019 and 2020, a total of 452 patients with laboratory-confirmed COVID-19 were admitted to our hospital.

In 2019, the total number of emergency patient requests was 2,136, and the total number of patients admitted was 1,811 (85%) (Table 2). In contrast, in 2020, the total number of emergency patient requests was 2,371, and the number of patients admitted was 1,822 (76%), which was a decrease ($p = 0.924$). As a result of the inclusion of the floating number of emergency calls, such as cancellations, call failures, and requests for instructions, in the actual number of emergency patients admitted, the number of patients for whom admission was refused was significantly higher in 2020 (506 patients, 21.3%) than in 2019 (303 pa-

Table 2. Emergency patient responses in 2019 and 2020

Response	2019		2020		<i>P</i>
	Monthly average	Total	Monthly average	Total	
Emergency request*	178	2,136	197	2,371	0.067
Admission	150	1,811 (85%)	151	1,822 (76%)	0.924
Admission refusal	25	303 (14.1%)	42	506 (21.3%)	≤ 0.01

*Emergency requests were not equal as the actual acceptances and refusal because of the floating number of emergency requests, such as cancellations and call failures.

tients, 14.1% ; $p \leq 0.01$).

In 2020, the number of operations by the departments of neurosurgery, cardiac surgery, and vascular surgery was greater than that in 2019 (Fig. 1). The average number of overtime hours per physician was also increased for those in the departments of neurosurgery, cardiac surgery, vascular surgery, cardiology, respiratory surgery, and gastrointestinal surgery (Fig. 2). The number of Nurses' incident reports registered in Safe Master[®] and the severity of the incidents are shown in Table 3. The number of incidents reported in the ICU in 2019 was 396 and had increased significantly in 2020 to 510 ($p \leq 0.01$) (Table 3).

The average monthly number of incidents of level 0 was significantly higher in 2020 than in 2019 ($p \leq 0.01$) (Table 3). However, the number of incidents of level 3b or

higher, which require intense treatment, increased from 3 in 2019 to 7 in 2020, but the difference was not significant (Table 3).

DISCUSSION

In 2020, hospitals throughout Japan began to give priority in their emergency systems to patients who had COVID-19 infections, and the emergency responses for other patients became a problem in every region. Our hospital, located in the northern part of Saitama Prefecture, was no exception, and gave priority to patients with COVID-19. Our hospital is one of the few hospitals in the region that admits patients with COVID-19 and patients with other severe conditions. Because the northern part of Saitama Pre-

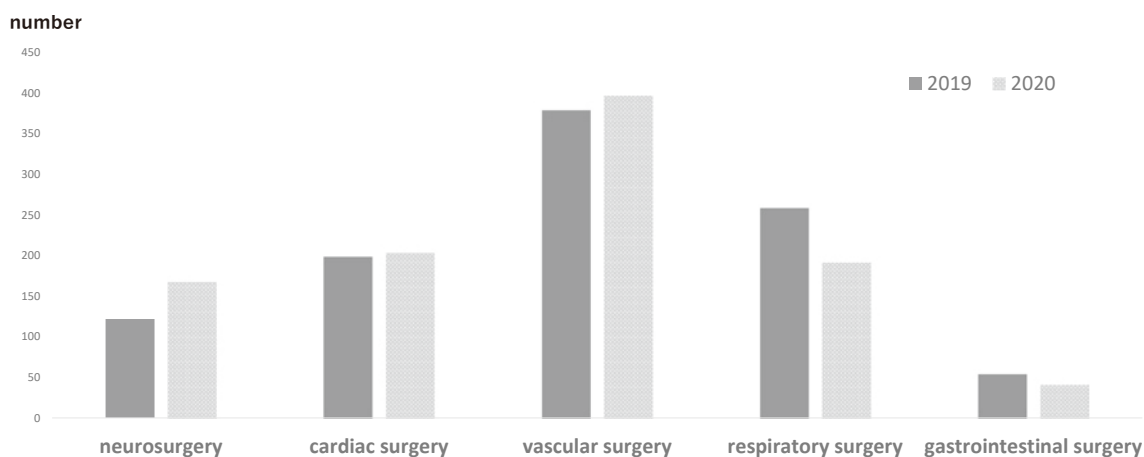


Fig. 1. Number of operations per surgical department in 2019 and 2020.

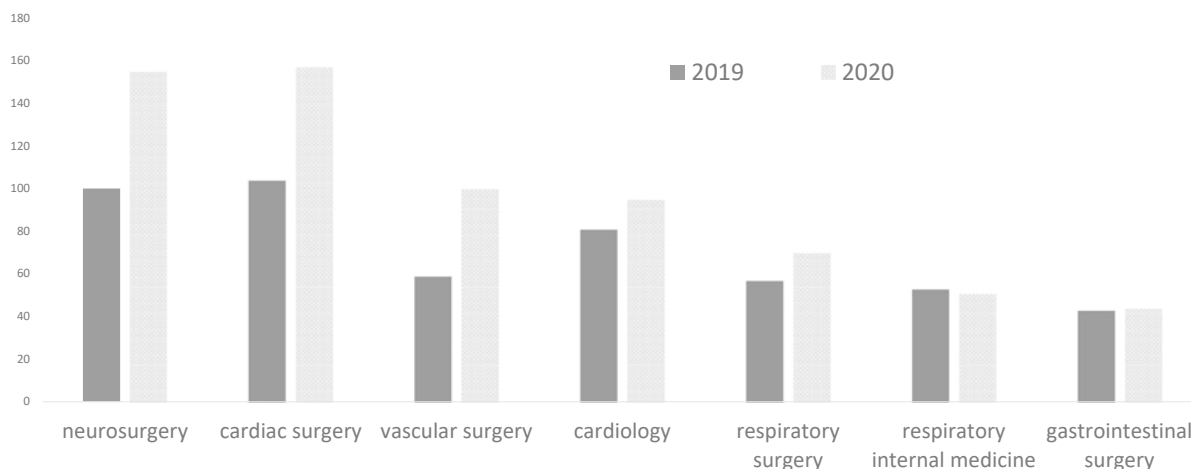


Fig. 2. Average hours of overtime work by physicians per surgical department in 2019 and 2020.

Table 3. Number of incident reports in 2019 and 2020

Incident Level	2019		2020		<i>P</i>
	Monthly average	Total	Monthly average	Total	
0	4.3	52	10.3	124	≤ 0.01
1	16.7	201	18.8	226	0.05
2	8.1	98	8.8	106	0.15
3a	3.5	42	3.9	47	0.48
3b	0.25	3	0.58	7	0.37
4a	0	0	0	0	
4b	0	0	0	0	
5	0	0	0	0	
Total	33	396	42	510	≤ 0.01

fecture is a depopulated area with few hospitals, the need for local medical care is higher than in urban areas. Decreases have been reported in the United States in the number of emergency admissions to Veterans Affairs hospitals for patients without COVID-19 infections¹ and the number of cardiac catheterizations performed³. However, such decreases do not apply to our hospital because it is in a rural area.

Even when COVID-19 infections were widespread in 2020, the total number of emergency patient requests increased for an unknown reason and confirmed that community-based emergency medical care needed to be developed. At the same time, our hospital, being a regional COVID-19 hospital, refused emergency admission for a higher percentage of patients than in 2019. A similar situation led to an increase in out-of-hospital cardiac arrests in Italy⁴. Moreover, for unknown reasons, the number of patients in our hospital undergoing operations in surgical departments, the main source of patients admitted to ICUs, increased in 2020. Of note is that the present study found that COVID-19 had no effect on the number of operations performed in 2020, compared with that in 2019. In the future, we must ensure that services for emergency patients are promptly available regardless of the situation of the pandemic.

The present study found that overtime work became more common for physicians of the departments of neurosurgery, cardiac surgery, and vascular surgery, which often refer patients to ICUs. This high amount of overtime work was thought to be partly due to the increased number of meetings and responses related to patients infected with COVID-19. A study of the effect of this situation in the ICU

showed surprising results compared with the situation before the COVID-19 pandemic in 2019⁵. The number of incidents reported in our ICUs and RCU was significantly greater in 2020 than in 2019. We believe a reason for this increase was the inadequate management system for critically ill general patients. The intensive care for patients with COVID-19 must be special, and medical personnel must take all possible precautions; hence, the use of ICUs for critically ill patients who did not have COVID-19 had to be restricted because of a labor shortage. The level of events was low in the majority of cases, however, indicating that a minimum level of control could be maintained even in the context of a high acceptance rate of patients who have COVID-19 infections.

In contrast, the present study found that the number of surgical operations for general critical care patients increased during the COVID-19 pandemic, reflecting the high demand for critical care management and overtime by physicians. The increase in the number of overtime work hours of physicians might have been influenced by the overload of work due to the COVID-19 pandemic, which was not part of the normal system of care.

Our results show that the environment in our region is challenging, and that physicians, nurses, and other medical staff work at the limit of their abilities. Nevertheless, efforts to treat emergencies, including COVID-19 infections, cannot be discontinued, and comprehensive national measures are needed to prevent the collapse of community healthcare.

The Japanese Ministry of Health, Labour and Welfare aims to reform how physicians work and has established a special level of overtime, which will come into effect in

April 2024, to manage the problem of the uneven distribution of physicians in rural areas. Nevertheless, this problem will not be solved unless the COVID-19 pandemic improves⁶. In addition to addressing working hours, also important is to ensure that special infection prevention measures are implemented for healthcare workers exposed to COVID-19, especially those involved in intensive care⁷. Phua et al. insisted that hospital administrators, governments, and policy makers must work with ICU practitioners to prepare for the substantial increase in critical care bed capacity and must protect healthcare workers from nosocomial transmission, physical exhaustion, and mental health issues⁸.

A challenge for the future is to improve the medical system and reduce the total number of incidents, even in situations where COVID-19 infections are widespread.

Limitations

The northern part of Saitama Prefecture is a depopulated medical area, and this study is limited in its generalizability to the entire area because the data was collected at a single institution. Furthermore, incident reports could not be assessed with the person-time method, which might not provide an accurate comparison. In addition, we compared the effects of COVID-19 over a 2-year period, and a longer observation period is needed. The results of this study might also have been affected by factors other than COVID-19. Also of note is that this study did not assess the effects of COVID-19 on mortality and other factors.

Conclusion

We investigated the current situation of intensive care during the COVID-19 pandemic in northern Saitama Prefecture. Even though intensive care management was restricted, the number of patients and the number of overtime work hours of physicians increased owing to the pandemic, and this environment led to an increase in the number of incidents. The environment of ICUs must be improved to prepare for more severe situations in the future.

Declarations

Author contributions : K.N. and K.O. made a substantial contribution to the concept and design of the work and the acquisition, analysis, and interpretation of data. K.N., T.K., and K.O. drafted the article and revised it critically for

important intellectual content. T.K. and M.N. provided administrative support. K.N. and K.O. provided the study materials and access to the patients. K.N. collected and assembled the data. K.N. and T.K. analyzed the data and interpreted the results. All authors helped in the manuscript writing and approved the version to be published.

Ethical statement : The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work were appropriately investigated and resolved. This study conformed to the provisions of the Declaration of Helsinki and all its amendments. This study was approved by the Institutional Review Board of the Saitama Cardiovascular and Respiratory Center (No. 2021013). Written informed consent was obtained from the patients for use of the data for academic publication purposes if the patient needed an operation.

Reporting checklist statement : We present the following article/case in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting checklist.

Authors have no conflicts of interest.

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