



Cardiology Department Practices in the First Wave of the Coronavirus Disease Pandemic

— A Nationwide Survey in Japan by the Japanese Circulation Society—

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Background: From the early phase of the Coronavirus disease-2019 (COVID-19) pandemic, cardiologists have paid attention not only to COVID-19-associated cardiovascular sequelae, but also to treatment strategies for rescheduling non-urgent procedures. The chief objective of this study was to explore confirmed COVID-19 cardiology case experiences and departmental policies, and their regional heterogeneity in Japan.

Methods and Results: We performed a retrospective analysis of a nationwide survey performed by the Japanese Circulation Society on April 13, 2020. The questionnaire included cardiology department experience with confirmed COVID-19 cases and restriction policies, and was sent to 1,360 certified cardiology training hospitals. Descriptive analysis and spatial autocorrelation analysis of each response were performed to reveal the heterogeneity of departmental policies. The response rate was 56.8% (773 replies). Only 16% of all responding hospitals experienced a COVID-19 cardiology case. High-risk procedures were restricted in more than one-fifth of hospitals, including transesophageal echocardiography (34.9%) and scheduled catheterization (39.5%). The presence of a cardiologist in the COVID-19 team, the number of board-certified cardiologists, any medical resource shortage and a state of emergency were positively correlated with any type of restriction.

Conclusions: We found both low clinical case experiences with COVID-19 and restrictions of cardiovascular procedures during the first COVID-19 wave in Japan. Restrictions arising as a result of COVID-19 were affected by hospital- and country-level variables, such as a state of emergency.

Key Words: Cardiology department; Coronavirus disease-2019 (COVID-19); Policy; State of emergency

Since the end of 2019, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and its associated Coronavirus disease-2019 (COVID-19) have spread throughout the world.¹ From the initial phases, cardiologists have paid attention to not only the cardiovas-

cular complications of COVID-19, but also the high mortality and morbidity of COVID-19 in patients with cardiovascular disease.^{2,3} In addition, due to shortages in personal protective equipment (PPE) and other medical resources, as well as the infectious nature of COVID-19,

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many hospitals have had to change their strategies for treating patients, especially with regard to rescheduling and postponing non-urgent procedures.^{4,5} In cardiology, many associations and groups, such as the American College of Cardiology and the American Society of Echocardiography, published recommendations in March 2020 that non-urgent procedures and outpatient clinic visits should be rescheduled.^{6,7} However, when and how to restrict routine practice may differ among countries, and will depend, in large part, on the situation, especially the number of COVID-19 patients. Furthermore, hospital and departmental policies could differ even within individual nations because the number of infected patients could vary among subnational regions, such as states and counties.⁸

In Japan, on April 7, 2020, the cumulative number of SARS-CoV-2 infections was 3,906 and a state of emergency was declared in 7 key subnational regional areas (i.e., prefectures): Tokyo, Saitama, Chiba, Kanagawa, Osaka, Hyogo, and Fukuoka.⁹ In addition, the Japanese Circulation Society and the Japanese Stroke Society published a Joint Declaration on COVID-19 and recommended that cardiovascular procedures are restricted, if possible, considering limited medical resources and appropriate care delivery.¹⁰ Because these societies do not have any legal authority, the stances and policies many of hospitals were based on their local situation, which could result in geographical heterogeneity. Unfortunately, no previous studies have addressed the non-uniformity of departmental policies. For the upcoming next wave of SARS-CoV-2 infections, we should know the country-level heterogeneity, local situation, and what could affect departmental policies. Thus, the chief objective of the present study was to explore confirmed COVID-19 cardiology case experiences and departmental policies, and their regional heterogeneity, in Japan.

Methods

Study Population

This was a retrospective analysis of a nationwide survey performed by the Japanese Circulation Society about COVID-19-related clinical practice, case experiences, and departmental policies in Japan. This nationwide survey was performed using Google Form, a web-based survey system, on April 13, 2020. On April 13, the total cumulative number of infections in Japan was 7,553, which is around the peak number of infected people in Japan.¹¹ The questionnaire was sent by e-mail to a total of 1,360 cardiology training hospitals authorized by the Japanese Circulation Society.¹² The survey was closed on April 20, 2020 (after 1 week), and study agreement was also included in the questionnaire. The total questionnaire required approximately 20 min to complete. Duplicate responses were deleted, leaving the newer response, and hospitals for which the geographical location could not be identified were also excluded.

This study was approved by the Institutional Review Board of the Japanese Circulation Society.

Questionnaire

The survey contained questions on the following topics for each institution: (1) confirmed COVID-19 case experience as a cardiology department; (2) hospital and departmental policies regarding COVID-19 patients; (3) departmental policies regarding rescheduling and postponing scheduled examinations and procedures for all patients, including non-COVID-19 patients; and (4) the medical resource situ-

ation and preparedness for COVID-19 patients in departments with no experience of COVID-19 patients. The questions were answered based on the time period ending on April 13, 2020. In this paper, we chiefly focus on departmental policy.

The definition of “case experience” for each department also covered a consultation for the cardiovascular department about the difficulties of cardiovascular risk factor management (e.g., angiotensin-converting enzyme inhibitors) and cardiovascular sequelae (e.g., COVID-19-associated myocardial injury and infarction in patients with COVID-19). The survey of hospital and departmental policies included questions about the presence of a cardiologist on the hospital-level COVID-19 team, the acceptance of COVID-19 cases, and consideration of the baseline risk of staff (e.g., diabetes and hypertension) when allocating shifts. The survey of departmental policy in each cardiology department also included questions about the presence of the following restrictions and rescheduling practices: outpatient clinic, emergency room, echocardiography for outpatients and inpatients separately, transesophageal echocardiography (TEE), computed tomography/magnetic resonance imaging in cardiology, scheduled coronary, peripheral, and right heart catheterization, scheduled ablation therapy, treadmill, cardiopulmonary exercise testing (CPX), group exercise therapy, and scheduled operations.

Data Linkage

Each response was linked to the following variables: the number of board-certified physicians by the Japanese Circulation Society, the total number of hospital beds, the total number of physicians, the geographical location of each hospital, and the cumulative number of SARS-CoV-2-infected patients in each prefecture on April 13, 2020. In addition, responses were linked to the hospital’s status as a Class I or Class II designated medical institution for infectious disease or not. A designated medical institution for infectious disease is a special institute for specified new, Class I, and Class II infectious diseases. Although COVID-19 could be treated regardless of whether the hospital was a designated medical institution, this could be an important variable when considering hospital policy.

The total number of hospital beds, the total number of physicians, and the geographical location of each hospital (including subnational area, prefecture) were linked by using the data provided by the Institute for Health Economics and Policy (<https://www.ihep.jp/publications/other/>, accessed April 20, 2020); the number of COVID-19 patients in each prefecture was obtained using the data summary from TOYO KEIZAI ONLINE (<https://toyokeizai.net/sp/visual/tko/covid19/>, accessed April 13, 2020) and officially reported by the Ministry of Health, Labour and Welfare in Japan (https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000121431_00086.html, accessed April 20, 2020).

Statistical Analysis

Continuous data are given as the mean \pm SD or as the median with interquartile range (IQR). The restriction rates for individual types of examinations and procedures in each prefecture were calculated by dividing the total number of hospitals with restrictions for each procedure by the total number of hospitals in each prefecture.

To estimate the effect considering the voluntary nature of responses to this questionnaire, a propensity score for the probability of response to the questionnaire was calcu-

Table 1. Baseline Characteristics of the Cardiology Training Hospitals Included in This Study (n=773 Respondents)	
Hospital variables	
Designated medical institution for infectious disease	221 (28.6)
Total no. physicians	131 [80–217]
No. board-certified cardiologists	5 [3–9]
Total no. hospital beds	376 [269–548]
Presence of a COVID-19 team	
Cardiologist part of the COVID-19 team	325 (42.0)
No cardiologist in the COVID-19 team	289 (37.4)
No COVID-19 team	124 (16.0)
Unknown	35 (4.5)
Prefecture variables	
Cumulative no. COVID-19-infected patients in each prefecture	272 [43–490]
State of emergency	313 (40.5)

Data are presented as n (%) or as the median [interquartile range].

lated by incorporating the number of hospital beds, board-certified cardiologists, total number of physicians, and SARS-CoV-2-infected cases in each prefecture.¹³ We created generalized estimating equation (GEE) models clustered by prefecture level to account for the clustering of data by adjusting the hospital and prefecture variables, including propensity score. The hospital variables adjusted for were: experiences regarding surgical mask shortages, the presence of cardiologists in the COVID-19 team, the total number of hospital beds, hospital COVID-19 cardiology case experience, the number of physicians and board-certified cardiologists, any medical resource shortage, and whether the hospital is a designated medical institution for infectious diseases. The prefecture variables adjusted for were: the number of cases in each prefecture and the presence of a state of emergency. Some continuous variables were categorized into 2 or 3 categories not to violate linearity assumptions. Statistical analyses were performed using R version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

The overall response rate was 56.8% (773 replies). **Table 1** shows the baseline characteristics of each hospital: 221 (8.6%) hospitals were designated as medical institutions for infectious disease and the median number of hospital beds was 376 (IQR 269–548). A COVID-19 team was assembled in 614 (79.4%) hospitals and a cardiologist was assigned to the team in 325 (42.0%) hospitals. Among the departments and hospitals that responded to the survey, 313 (40.5%) hospitals were in a prefecture in which a state of emergency had been declared.

The survey also showed that only 16% of all departments had experienced a COVID-19 cardiology case. Even in those hospitals that had experienced such a case, the total number of cases was quite small (**Supplementary Table 1**). One-tenth of departments had experienced more than 5

Table 2. Departmental Policy in the Cardiology Department (n=773 Respondents)	
	No. respondents (%)
Does your department restrict the following cardiology department functions for non-COVID-19 patients?	
Outpatient clinic	132 (17.1)
Emergency room	114 (14.7)
Echocardiography for outpatients	108 (14.0)
Echocardiography for inpatients	72 (9.3)
TEE	270 (34.9)
CT/MRI in cardiology	37 (4.8)
Scheduled coronary, peripheral, and right heart catheterization	305 (39.5)
Scheduled catheterization (ablation therapy)	215 (27.8)
Treadmill	130 (16.8)
CPX	161 (20.8)
Group exercise therapy	142 (18.4)
Scheduled operations	136 (17.6)

CPX, cardiopulmonary exercise testing; CT, computed tomography; MRI, magnetic resonance imaging; TEE, transesophageal echocardiography.

COVID-19 cases with typical cardiovascular disease diagnoses. Extracorporeal membrane oxygenation (ECMO) experiences for cardiovascular diagnoses were only reported in less than one-tenth of departments. Conversely, more than 70% of departments had experienced medical resource shortages, especially of N95 masks and surgical masks (**Supplementary Table 2**).

Department policies about restrictions in the cardiology department are listed in **Table 2**. Restrictions of cardiovascular care were experienced in less than half the departments. Scheduled catheterization was most frequently (39.5%) restricted, followed by TEE (34.9%). Most procedures were restricted in one-fifth of departments. **Table 3** shows the relationship between each of the hospital and prefecture variables and departmental policy regarding restrictions, after adjustment by the GEE model. The presence of a cardiologist on the COVID-19 team, any medical resource shortage, the number of board-certified cardiologists, and a declared state of emergency were all positively related to any of the restriction policies in the cardiology department. These hospital and prefecture variables were strongly correlated with each of the respective restriction policies (**Supplementary Table 3**).

Discussion

This study was a retrospective analysis of a nationwide survey regarding the clinical situation in cardiology departments during the COVID-19 era. First, the study revealed that less than one-fifth of hospitals reported experiencing COVID-19 cardiology cases, which is small compared with the overall number of reported COVID-19 patients in April 2020. Second, this study revealed cardiology department restriction patterns in the first wave of the COVID-19 pandemic, which were affected by several cardiologist factors, such as the presence of a cardiologist on the COVID-19 team and the number of board-certified cardiologists. In addition, considering the negative effect of reported COVID-19

Table 3. Multivariate Analysis Results (Generalized Estimating Equations) ^A			
Variables	OR (95% CI)	P value	
Hospital variables			
Presence of a cardiologist in the COVID-19 team	1.70 (1.22–2.36)	<0.01 ^B	
COVID-19 case experiences	1.51 (0.88–2.60)	0.13	
Any medical resource shortage	2.27 (1.17–4.42)	0.02 ^B	
No. board-certified cardiologists (higher half vs. lower half [reference])	1.82 (1.22–2.71)	<0.01 ^B	
Total no. hospital beds			
T2 vs. T1 (reference)	1.02 (0.68–1.55)	0.91	
T3 vs. T1 (reference)	1.16 (0.66–2.06)	0.60	
Total no. physicians (higher half vs. lower half [reference])			
Designated medical institution for infectious diseases	1.34 (0.91–1.97)	0.14	
Prefecture variables			
No. cases in each prefecture			
T2 vs. T1 (reference)	1.02 (0.69–1.51)	0.93	
T3 vs. T1 (reference)	1.25 (0.60–2.63)	0.55	
State of emergency	1.90 (1.04–3.45)	0.04 ^B	

^AMultivariate analysis adjusted using propensity scores for questionnaire responses. ^BP<0.05. CI, confidence interval; OR, odds ratio; T1, first tertile; T2, second tertile; T3, third tertile.

numbers and the high impact of a declared state of emergency on restrictions, each restriction may be dependent on policymaker decisions, either at the hospital or country level.

COVID-19 and Cardiology

The relationship between cardiovascular disease and COVID-19 has been reported from the early stage of the pandemic.¹⁴ Driggin et al summarized cardiovascular healthcare worker considerations about COVID-19 into 4 segments (represented by a 2×2 table): with/without prior cardiovascular disease and COVID-19 positive/negative.³ In COVID-19-positive patients, attention should be paid to cardiovascular sequelae, such as myocarditis, heart failure, cardiogenic shock, acute coronary syndrome, venous thromboembolism, and stress cardiomyopathy. Conversely, in SARS-CoV-2-negative patients, attention should be paid to general prevention and risk stratification, including prioritizing high-risk visits and procedures.³ The present nationwide survey revealed that similar confirmed COVID-19 cardiology cases could be observed in Japan; however, experiences in each hospital were limited. Although no previous study has evaluated cardiology experiences in confirmed COVID-19 patients in Japan, this study revealed that less than one-fifth of certified training hospitals had experienced a COVID-19 cardiology case in April 2020. Taking into account previous reports of a >20% rate of cardiovascular sequelae and 7,553 cumulative case experiences in Japan in April 2020, the number of cases experienced in this study seems slightly low.¹⁵ Considering the report of myocardial injury detected by magnetic resonance imaging even in asymptomatic patients, long-term follow-up for chronic myocarditis and heart failure should be considered.¹⁶

Restrictions for Cardiovascular Care Procedures

Cardiovascular care and procedures were restricted in approximately 40% of hospitals during the first wave of the COVID-19 pandemic in Japan. This study revealed high-risk procedures and treatments, such as TEE, catheterization, and CPX, which are associated with aerosolization, were frequently restricted. Although there have been lim-

ited studies about restrictions of cardiovascular procedures during the first wave of the COVID-19 pandemic, Gaudino et al performed an international survey about cardiovascular surgery in March 2020 and reported that one-third of centers had restricted more than 50% of their cardiac operating rooms and intensive care units.¹⁷ Mohamed et al summarized the Hospital Episode Statistics (HES) dataset and revealed a significant reduction (>50%) in major cardiovascular procedures, such as catheterization and operations, that could be associated with 30-day mortality, especially for catheterization.¹⁸ Any medical resource shortage had a significant effect on the restriction of departmental procedures and care. Many hospitals lacked medical resources, especially PPE and especially in April. Improvements in the nationwide supply chain, international collaborations, new technological advances, and the appropriate allocation of medical resources across the country have been rapidly implemented and have slightly improved the shortage in medical resources compared with early 2020.^{19,20} Future studies validating the relationship between restriction policies and outcomes are needed.

Effects of Hospital- and Country-Level Policies on Restrictions

Departmental restrictions could be implemented for several reasons, such as the total number of COVID-19 patients, medical resource shortages, recommendations and statements from professional societies, and national-level orders. This study revealed that several variables were associated with the restrictions. Of note, it was not the number of infectious patients, but rather other parameters, such as the presence of a cardiologist on the COVID-19 team, the number of board-certified cardiologists, any medical resource shortage, and a state of emergency, that were positively correlated with the restrictions. The presence of a cardiologist on the COVID-19 team and a higher number of board-certified cardiologists would contribute to the smooth sharing of information and rapid decision making. We also found that a declared state of emergency had an impact on restrictions. Country- and subnational-level decisions,

such as lockdowns of hospitals, and departmental decision making had not been fully evaluated in the COVID-19 pandemic. Orders such as a declared state of emergency in Japan had no legal binding force and were called “voluntary lockdown”, which is different from the lockdown imposed in other countries.²¹ However, the effect of voluntary lockdown in Japan was considered similar to that of the enforced lockdown in other countries. The same could be true of subnational-level decisions, such as a declared state of emergency. In addition, as in many countries, some guidance and statements from the Japanese Circulation Society and other associations about recommendations to restrict non-urgent procedures, considering the local situation, could also be indirectly related to restrictions.¹⁰ The effects of policy at each level (departmental, hospital, and subnational/country) should be investigated further.

Study Limitations

This study has several limitations. First, the response rate was <60%. Although we adjusted propensity scores for questionnaire responses, we cannot deny sampling biases. Second, our model was composed of limited variables. There are additional, unmeasured variables that can be included to estimate the impact on departmental policy more precisely. For example, because almost all hospitals experienced some kind of medical resource shortage, more detailed information about medical resource shortages could reveal their effects on the decision-making process regarding restrictions.

Conclusions

We have examined real clinical practices and restrictions of cardiovascular care and procedures in the first wave of the COVID-19 pandemic in Japan. The data show that less than one-fifth of hospitals experienced COVID-19 cardiology cases during the first wave of the COVID-19 pandemic. Hospital- and subnational-level policies could have some impact on departmental policy.

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Disclosures

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IRB Information

This study was approved by the Japanese Circulation Society Ethics Committee (No. 11-1) and was performed in accordance with the Declaration of Helsinki and the ethical standards of the responsible committee on human experimentation.

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Supplementary Files

Please find supplementary file(s); <http://dx.doi.org/10.1253/circrep.CR-21-0002>