Original Article

Japanese medical students' awareness of cardiopulmonary resuscitation in the context of the COVID-19 pandemic

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ABSTRACT

Aim: To evaluate Japanese medical students' awareness of newly recommended cardiopulmonary resuscitation (CPR) and airway management procedures in the context of the coronavirus disease (COVID-19) pandemic.

Methods: An online survey was sent in December 2020 to all medical students at Hirosaki University in Japan. The survey included 15 questions and quizzes regarding prior experience of learning the new CPR guidelines in response to COVID-19, knowledge of conventional CPR, and COVID-19 context CPR and airway management procedures.

Results: Of all medical students at the university, 457 (57.1%) responded to the survey. Among these, 22% reported that they were knowledgeable about CPR procedure in the COVID-19 pandemic setting. Prior knowledge of CPR in the context of COVID-19 was a significant positive predictor of quiz score regarding the CPR procedure (β = 0.60, P < 0.01) and the airway management procedure (β = 0.34, P = 0.02) in the context of the COVID-19 pandemic.

Conclusions: Medical students with experience learning the new COVID-19 context CPR guidelines had sufficient knowledge of CPR and advanced airway management procedures in the setting of the COVID-19 pandemic. Implementation of a formal medical education curriculum based on the newly recommended CPR and advanced life support guidelines is needed to improve medical students' awareness and skills of CPR and airway management in the context of the COVID-19 pandemic.

Key words: Airway management, cardiopulmonary resuscitation, COVID-19, education curriculum, medical student

INTRODUCTION

THE RAPID SPREAD of the severe acute respiratory syndrome coronavirus 2 and the potential for severe illness associated with the infection have led the International Liaison Committee on Resuscitation,[1,2] the American Heart Association,[3] the UK Resuscitation Council,[4] and other international societies to propose modified guidelines for cardiopulmonary resuscitation (CPR) during the coronavirus disease (COVID-19) pandemic.

The Japan Resuscitation Council and other organizations in Japan have published CPR guidelines, manuals, and algorithms for health-care providers and laypersons, and these

have also been provided for advanced life support (ALS) procedures, including airway management.[5,6]

Japanese health professionals have implemented these new recommendations for CPR procedures in the context of the COVID-19 pandemic; however, there has been no governmental initiative to incorporate COVID-19 context CPR procedures into the official medical education curriculum in Japan. Japanese medical students still acquire knowledge and learn skills for conventional CPR in the national core curriculum for undergraduate medical education, but the guidelines for the preclinical objective structured clinical examination have not been updated in response to the COVID-19 pandemic.[7] Therefore, it is unclear whether medical students have recognized the changes in CPR procedures in Japan. For example, a survey that investigated medical students' awareness of medical knowledge related to COVID-19 in Turkey showed that only 34% of final-year medical students knew CPR procedures in the context of the COVID-19 pandemic.[8] No study has investigated Japanese

medical students' awareness of modified CPR and ALS procedures in the context of the COVID-19 pandemic.

Therefore, this study aims to describe and evaluate Japanese medical students' awareness of the newly recommended CPR and ALS airway management procedures in the context of the COVID-19 pandemic. The evidence provided in this study can be used to modify CPR and ALS content in the core curriculum and to adjust guidelines for undergraduate resuscitation education in response to the current COVID-19 pandemic as well as in future pandemics.

METHODS

Study design

WE UNDERTOOK A cross-sectional questionnaire survey at Hirosaki University to evaluate medical students' knowledge of CPR and ALS procedures in the COVID-19 context. We hypothesized that their knowledge of the procedures would depend on their year level, degree of understanding of basic CPR, and other learning opportunities regarding CPR for COVID-19 patients.

Context

The CPR procedure for the COVID-19 pandemic context is not included in the official medical education curriculum at Hirosaki University. However, the faculty of the Department of Emergency and Disaster Medicine had partially implemented COVID-19-related resuscitation components in the intensive introduction to clinical medicine (IICM) program for 4th year medical students, and in the emergency medicine rotation curriculum in the clinical clerkship for 5th year medical students in 2020. The small group-based IICM program for 4th year students starts in November and runs until the end of December, and each group receives 3 h of hands-on conventional CPR training and a brief introduction to resuscitation in the COVID-19 context, which includes additional recommendations regarding wearing personal protective equipment (PPE), performing chest compression-only CPR if the rescuer is unable to provide rescue breaths to minimize aerosol exposure, and using HEPA filters with bag-mask ventilation when providing rescue breaths.

The clinical clerkship students rotate through the emergency department in groups of six or seven every 2 weeks throughout the year. Each group learns COVID-19 context resuscitation by scenario-based flipped classroom education. The content includes airway management (e.g., two-person bag-mask techniques, intubation by experienced and competent physicians, and use of intubating devices to increase the success rate). We implemented flipped-classroom style resuscitation education in September 2020 after the suspension of emergency medicine clerkship due to the COVID-19 pandemic. Therefore, approximately 30%–40% of 4th and 5th year medical students had received the resuscitation education mentioned above at the time of the survey. We did not have any opportunities to teach resuscitation to other students at our university.

Participants

All medical students at Hirosaki University were invited to participate in this study. We communicated with the 1st–6th year student representatives, who then sent social network service (SNS) messages asking all students to fill out the online survey.

Data collection

An online questionnaire survey was conducted using Microsoft Forms in December 2020. The survey included one general question and 14 items categorized into three sections: a knowledge quiz about (A) basic CPR including four questions, (B) CPR for laypersons in the COVID-19 context including four questions, and (C) airway management procedures for patients with suspected or confirmed COVID-19 that included six questions.

We first asked all students whether they had ever learned, by any medium, the procedure for CPR in the setting of the COVID-19 pandemic as a general question. We then asked junior (1st–3rd year) students items from two sections (A and B) regarding basic CPR and CPR for the layperson in the COVID-19 context, and asked senior (4th–6th year) students items from all three sections (A, B, and C), as section C included questions requiring knowledge of advanced airway management as well as PPE technique. One point was given for each correct answer; thus, the maximum points for sections A, B, and C were 4, 4, and 6, respectively. The questionnaire samples are shown in Figure 1. The items were determined based on the questionnaires used in previous studies.[8–10]

Figure 1. Questionnaire distributed to Japanese medical students to determine awareness of cardiopulmonary resuscitation (CPR) in the context of the COVID-19 pandemic. AED, automated external defibrillator.

Fundamental question	
Have you ever learned, by any media, the procedure for CPR in the setting of the COVID-19 pandemic?	Yes or No

Section A (Basic CPR)	
In adult basic life support, which of the following is the appropriate sequential procedure of basic life support (Choose one)?	A. Check the victim's consciousness, check for breathing, call for an ambulance and AED, and start chest compressions. B. Call for an ambulance and AED, check the victim's consciousness, check for breathing, and start chest compressions. C. Check the victim's consciousness, call for an ambulance and AED, check for breathing, and start chest compressions.
In adult basic life support, which of the following is the appropriate depth of chest compressions (Choose one)?	A. 2cm B. 3cm C. 4cm D. 5cm
In adult basic life support, which of the following is the appropriate rate of chest compressions (Choose one)?	A. 60~80 compressions per minute B. 80~100 compressions per minute C. 100~120 compressions per minute D. 120~140 compressions per minute
In adult basic life support, which of the following is the appropriate ratio of chest compressions to ventilations (Choose one)?	A. 15:2 B. 30:1 C. 60:2 D. 30:2

Section B (CPR in the context of COVID-19) Which of the following is the appropriate basic life support procedure in the situation of COVID-19 pandemic?	
There should be no more person other than the medical personnel who are absolutely in necessary number during procedures that may cause aerosolization such as CPR.	Yes or No
Rescuers should not place their own face too close to the face of the victim when checking for response and breathing.	Yes or No
During chest compressions, they should cover the victim's nose and mouth with a surgical mask, handkerchief or towel to prevent splashing.	Yes or No
In adult basic life support by citizens, chest compressions and defibrillation with an AED should be performed but artificial respiration should not.	Yes or No

Section C (Airway management procedure in the context of COVID-19 pandemic) Which of the following is the appropriate airway management procedure?	
Risk of aerosolization increases during a bag-valve mask ventilation.	Yes or No
The compressor should continue compressing the chest during the attempt of endotracheal intubation.	Yes or No
Chest compression does not generate aerosolization.	Yes or No
Wearing a face shield does not improve safety unless the intubator also wears N95 mask.	Yes or No
A series of intubation procedures consisting of steps such as laryngeal expansion with a laryngoscope and insertion of the tracheal tube should be performed by the most experienced person in the emergency room.	Yes or No
When intubating, the device with the highest likelihood of initial successful placement should be used.	Yes or No

Data analysis

Students' awareness of COVID-19 context CPR and the quiz score for each section (A, B, and C) were summarized according to year level. Multiple regression analyses were carried out to determine the predictors of medical students' knowledge acquisition of CPR and airway management procedures in the COVID-19 pandemic. We then created a COVID-19 CPR model for 1st–3rd year students and an airway management knowledge model for 4th–6th year students. Statistical analyses were undertaken using the EZR software package.[11]

Ethics

This study was exempted from review by the Ethics Committee of the Hirosaki University Graduate School of Medicine. Consent from the participants for study participation was obtained electronically.

RESULTS

A TOTAL OF 457 (57.1%) of all medical students at Hirosaki University responded to the survey. The percentages of 1st–6th year students who reported that they had already learned about CPR for COVID-19 were, in order of year level, 29.2% ($n = 21$), 10.5% ($n = 8$), 9.4% ($n = 10$), 41.2% ($n = 35$), 30.7% ($n = 19$), and 16.7% ($n = 9$). The mean scores on the basic CPR quiz of 1st–6th year students were, in order of year level, 1.8 (standard deviation [SD] 1.0), 1.5 (SD 1.1), 1.6 (SD 1.1), 3.7 (SD 0.7), 2.7 (SD 1.1), and 3.4 (SD 0.7). The mean scores on the COVID-19 context CPR quiz of 1st–6th year students were, in order of year level, 2.9 (SD 1.0), 2.8 (SD 1.1), 3.1 (SD 1.0), 3.2 (SD 0.8), 3.2 (SD 1.1), and 2.7 (SD 1.0). The mean scores in the COVID-19 context airway management quiz of the 3rd, 4th, and 6th year students were 3.7 (SD 0.9), 3.5 (SD 1.0), and 3.2 (SD 1.0), respectively (Table 1).

A multiple regression model for the scores on the COVID-19 context CPR procedure quiz indicated that prior knowledge of COVID-19 context CPR, score on the quiz of basic CPR procedure, and year level in medical school accounted for 6% of the variance in the COVID-19 context CPR score ($F [4, 250] = 4.12$, $P < 0.01$). Prior knowledge of COVID-19 context CPR was a significant positive predictor for quiz score on the CPR procedure in the context of the COVID 19 pandemic ($\beta = 0.60$, $P < 0.01$). Year level (3rd year versus 1st year students) was also found to be a positive predictor of score ($\beta = 0.32$, $P = 0.04$) (Table 2).

A multiple regression model for the scores of the airway management procedure quiz indicated that prior knowledge of COVID-19 context CPR, scores on the basic CPR procedure and COVID-19 context CPR quizzes, and medical school year level explained 8% of the variance in the airway management procedure score ($F [5, 195] = 3.47$, $P < 0.01$). Prior knowledge of COVID-19 context CPR was a significant positive predictor of quiz score for the airway management procedure ($\beta = 0.34$, $P = 0.02$). Student year level and quiz scores for basic CPR and COVID-19 context CPR were not predictors of quiz score for the airway management procedure (Table 3).

DISCUSSION

TO THE BEST of our knowledge, this is the first survey to report Japanese medical students' awareness of the recommended CPR and airway management procedures for the COVID-19 pandemic. We found that students' prior experience of learning the new CPR procedure for the COVID-19 pandemic was a positive predictor of quiz score

Table 1. Results of experience and quiz scores to determine awareness of cardiopulmonary resuscitation (CPR) in the context of the COVID-19 pandemic among Japanese medical students, according to year level

Year level	1 ($n = 71$)	2 ($n = 76$)	3 ($n = 107$)	4 ($n = 85$)	5 ($n = 62$)	6 ($n = 54$)
Prior experience of learning COVID-19 context CPR, *n* (%)	21 (29.2)	8 (10.5)	10 (9.4)	35 (41.2)	19 (30.7)	9 (16.7)
Quiz score, section A mean (SD)	1.8 (1.0)	1.5 (1.1)	1.6 (1.1)	3.7 (0.7)	2.7 (1.1)	3.4 (0.7)
Quiz score, section B mean (SD)	2.9 (1.0)	2.8 (1.1)	3.1 (1.0)	3.2 (0.8)	3.2 (1.1)	2.7 (1.0)
Quiz score, section C mean (SD)	–	–	–	3.7 (0.9)	3.5 (1.0)	3.2 (1.0)

Questionnaire sections A–C (Table 1). Covered the following topics: A, basic CPR; B, CPR for laypersons in the COVID-19 context; C, airway management procedures for patients with suspected or confirmed COVID-19.
–, not applicable; SD, standard deviation.

Table 2. Simultaneous multiple regression analysis model for junior medical students' knowledge of the cardiopulmonary resuscitation (CPR) procedure in the COVID-19 context

Variable	β	P
Constant	2.65	<0.01
Prior experience of learning COVID-19 context CPR	0.60	<0.01
Year 1 (Reference)	–	–
Year 2	0.01	0.94
Year 3	0.32	0.04
Score of basic CPR quiz (Section A)	0.03	0.56

–, not applicable.

Table 3. Simultaneous multiple regression analysis model for senior medical students' knowledge of the airway management procedure in patients with confirmed or suspected COVID-19

Variable	β	P
Constant	2.90	<0.01
Prior experience of learning COVID-19 context CPR	0.34	0.02
Score of basic CPR quiz (Section A)	0.10	0.22
Score of COVID-19 context CPR quiz (Section B)	0.10	0.16
Year 4 (Reference)	–	–
Year 5	−0.05	0.75
Year 6	−0.28	0.11

–, not applicable; CPR, cardiopulmonary resuscitation.

for COVID-19 context CPR and airway management procedures in patients with confirmed or suspected COVID-19. Other variables such as students' grades and basic CPR knowledge level were insignificant predictors of these scores.

Our findings indicate that knowledge of basic CPR might not be transferrable to answering a quiz on procedures for COVID-19 context CPR, which is related to the fact that concepts of aerosol transmission are less strongly emphasized in conventional CPR.[12] However, students who learned concepts regarding CPR specific to COVID-19 may have effectively retained knowledge of COVID-19 context CPR and airway management procedures. It is therefore reasonable for the faculty at medical schools to implement a new curriculum for CPR procedure in the context of the COVID-19 pandemic in each school, as there is presently no national medical education curriculum for this new procedure.[13,14]

The 4th and 5th year students scored the highest in the COVID context CPR and airway management procedure tests, for the reason that medical students are mainly taught COVID-19 related topics in a small-group emergency medicine rotation in the preclinical clerkship (4th year students) and clinical clerkship (5th year students) at our university, which could indicate the effectiveness of instruction in the emergency medicine rotation. However, students of other grades have unfortunately not had the opportunity to learn COVID-19 context CPR. In Malaysia, a study was undertaken on the knowledge of and confidence in performing lifesaving procedures in the face of the COVID-19 pandemic among emergency health professionals such as physicians, paramedical assistants, and nurses. The results showed that 68.9% of subjects had a high level of knowledge about airway management and cardiopulmonary resuscitation for COVID-19 patients.[9] Therefore, it may be possible for Japanese medical students to acquire essential knowledge regarding COVID-19 context CPR and airway management if adequate learning opportunities are provided. Specifically, two-person bag-valve mask ventilation with PPE is an essential airway management skill for senior medical students to learn.

There are limitations to this study. Although the medical students' CPR skills and their previous experience in CPR training could be confounding factors in the test results, we did not assess these factors as we focused on their basic knowledge of CPR. In addition, we could not teach COVID context CPR and airway management procedures to all of the students, even for senior students, due to restrictions imposed in response to the pandemic. Therefore, a further study that includes more diverse components, such as knowledge, skills, and attitude, is needed after fully implementing COVID context resuscitation.

CONCLUSIONS

MEDICAL STUDENTS ' knowledge of COVID-19 context CPR and airway management procedures was associated with prior opportunities to learn about COVID-19 in medical school. The implementation of a formal medical education curriculum on COVID-19 context CPR and airway management is necessary to improve medical students' awareness and skills.

DISCLOSURE

APPROVAL OF THE research protocol: This study was exempted from review by the Ethics Committee of Hirosaki University, Graduate School of Medicine.

ACKNOWLEDGMENTS

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