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Do Video Calls Improve Dispatcher-Assisted First Aid for Infants with Foreign Body Airway Obstruction? A Randomized Controlled Trial/Simulation Study

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Background: Because choking quickly leads to cardiopulmonary arrest, it is crucial that bystanders remove foreign bodies effectively. Although oral instructions in video calls by dispatchers have improved the quality of cardiopulmonary resuscitation, it is unclear whether video calls improve the quality of first aid for choking infants. Therefore, this simulation study aimed to determine whether video calls with dispatchers improve the quality of first aid for infants with foreign body airway obstruction (FBAO).

Methods: Seventy first-year college students randomly assigned in pairs to communicate by video or audio calls participated in simulated emergency calls for infants with FBAO. Both groups began with oral instruction in voice calls until the transition was made to video calls in the video group. The primary outcome was quality of first aid performance, which was categorized as excellent, acceptable, or poor on the basis of existing guidelines.

Results: There were 17 simulations in the video-call groups and 16 in the voice-call groups. After initial oral instruction, the proportion of rescuers that received an evaluation of excellent or acceptable did not differ significantly between the groups (video, 41% vs. voice, 50%; P=0.61); however, evaluations for seven rescuers improved after transitioning to video calls. Ultimately, the proportion receiving a poor evaluation was significantly lower in the video-call group than in the voice-call group (50% vs. 82%, P= 0.049).

Conclusion: Oral instruction communicated by video calls improved the quality of first aid for infants with FBAO. (J Nippon Med Sch 2022; 89: 526–532)

Key words: airway obstruction, first aid, pediatric emergency medicine, emergency ambulance system, prehospital care

Introduction

Foreign body airway obstruction (FBAO) is an airway emergency and an important cause of morbidity and mortality during childhood[1]. Most cases of FBAO occur in children younger than 3 years, with a peak between age 1 and 2 years[2]. In the United States, FBAO resulted in 17,000 emergency visits for children younger than 14 years. It was the leading cause of accidental death among infants and the fourth leading cause of death among preschoolers (age ≤5 years)[3].

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https://doi.org/10.1272/jnms.JNMS.2022_89-513
Journal Website (https://www.nms.ac.jp/sh/jnms/)

Because cardiac arrest can occur if a foreign body is not removed quickly, having a bystander administer first aid is crucial. When a bystander did not remove a foreign object before emergency services arrived, the reported rate of favorable neurological outcomes was lower than when the object was removed by a bystander[4]. However, only 42% of bystanders provided correct first aid for adult patients with FBAO[5]. The rate of correct practice of first aid for choking in infants younger than 1 year may be even lower, since it differs from first aid for adults and those older than 1 year.

If a bystander is unable to perform appropriate first aid, it is important for the dispatcher to provide instructions, as dispatcher-assisted cardiopulmonary resuscitation (CPR) improves survival rates and neurological outcomes[6–9]. Furthermore, both prehospital return of spontaneous circulation and survival to hospital discharge were better after video-instructed dispatcher-assisted CPR than after audio-instructed dispatcher-assisted CPR[10,11]. With the increasing use of smartphones, oral instruction via video call might improve the quality of first aid other than CPR. However, no studies have examined the efficacy of video calls for first aid for patients with FBAO.

This simulation study aimed to compare the efficacy of video calls with dispatchers to voice-only calls in improving the quality of first aid for infants with FBAO before the arrival of emergency responders.

Methods

Study Design and Population

We simulated first aid for choking infants younger than 1 year, which was administered by first-year college students enrolled in a health sciences department. The students had not learned first aid for infant choking in class and were not informed of the simulation in advance. We excluded students who had completed training in first aid for choking infants. Students were placed in pairs and randomly assigned to the video-call or voice-call groups. One student administered first aid while the other made the emergency call.

Four faculty members, all certified emergency responders, acted as dispatchers. The median age of the dispatchers was 45.5 years (range 44-60 years), and the median duration of experience as emergency responders was 23.5 years (range, 20-41 years). Although they had no experience as dispatchers, they were trained in the protocol in advance.

A mannequin (Baby Anne, Laerdal, Stavanger, Norway) was used to represent the infant, and a facilitator provided needed information, such as physical findings.

Participants provided consent after being informed that they had the right not to participate in the study. This study was approved by the ethics committee of Nippon Sport Science University (020-H079).

Dispatch Protocol

Because video calls typically take longer to connect than voice calls, it was decided that both groups would initially receive oral instructions via a voice call and that the video-call group would transition to oral instructions via a video call once the connection was made. This is consistent with the video call dispatch protocol currently being trialed by the Tokyo Fire Department.

The following protocol for the simulation was created in advance based on the protocol of the Japanese Fire and Disaster Management Agency and the CPR guidelines of the American Heart Association (AHA) and European Resuscitation Council (ERC) (**Table 1**)[12–14]. In this scenario, parents bring an 11-month-old boy to a student volunteering at a festival. The boy has put a small ball in his mouth. He is responsive but unable to make any noise and appears to be struggling. The parents are upset and ask for first aid and for emergency services to be called. On a voice call, a dispatcher instructs the rescuer on how to perform the back blow on the infant. In the video-call group, the dispatcher sends a web link to the student's mobile phone and the student then connects to this web link to start the video call. After the video call starts, the caller films the first aid with the mobile phone and the dispatcher provides feedback. In both groups, the simulation stops 4 minutes after the start of the simulation.

Communications Technology

The caller used an iPhone 11 (Apple Inc., Cupertino, California, USA) over a 4 G network. The default call mode was set to hands-free audio so that the rescuer could also hear the oral instructions. This was done for both groups to enable direct comparison of the effects of voice and video calls.

In the video-call group, the dispatcher used a laptop computer with video communications software (Ryobi Systems Co., Ltd., Okayama, Japan). A WiFi connection with a maximum download speed of 187.5 Mbps was used for the transmissions. During the video call, the dispatcher viewed the video sent from the mobile phone on the computer. While watching the video, the dispatcher could give instructions to the caller on the first-aid method and the position of the phone camera, if needed.

Table 1 Protocol for the simulation

Time (min:s)	Dispatcher	Caller (example)
0:00	*Simulation starts*	
	This is 119, fire department. Is it a fire? Is it an emergency?	I need an ambulance.
	Please tell me the address for the ambulance.	It is 1221-1, Kamoshida.
	What is happening?	A little boy appears to be choking.
	About how old?	11 months.
	Is he conscious? Is he responsive to your voice?	He's responsive.
	Is he breathing comfortably? Is he breathing normally?	He seems to be struggling.
	Is he shivering or sweating? Is he pale?	He doesn't look good.
Start of first aid	I'm going to instruct you on how to administer first aid. Is that ok?	Ok.
	The ambulance is coming. Please stay calm.	
	Please perform what I say.	
	It seems like the child cannot speak, so put him on your left arm, supporting his jaw with your palm. The infant's head should be placed lower than their body. Strike the middle of his back with your other palm.	
	Video call group only: I'm texting you a URL to click on so that you can send me video.	
	Continue until the object that is stuck comes out. Let me know if he loses consciousness.	
4:00	*Simulation ends*	

Fig. 1 Evaluating first aid performance for choking infants
(A) Performance was evaluated as excellent when adherence to oral instructions was complete and the following three points were satisfied: 1) position the infant face down, 2) support the infant's chin with your palm, and 3) place the infant's head lower than their body.
(B) Performance was evaluated as acceptable when adherence to oral instructions was not complete but the three points above were satisfied. The infant is placed on the knee in this figure, instead of on the forearm.
(C) Performance was evaluated as poor when at least one of the three above points were not satisfied. The infant's head is higher than the body in this figure.

Evaluation and Outcomes

The AHA, ERC, and American Academy of Pediatrics guidelines include three main recommendations regarding first aid for choking infants and CPR for infants[12,14–16]. The following three points are recommended for first aid for choking (**Fig. 1**): (1) the infant should be positioned face down, (2) the infant's chin should be supported with the rescuer's palm, and (3) the infant's head should be placed lower than their body.

On the basis of these recommendations, an evaluation (excellent, acceptable, or poor) was made independently by two emergency physicians (Y.I. and Y.Y.), after the initial oral instruction and at the end of first aid for choking simulation. If the opinions of the evaluators differed, consensus was reached by discussion. An evaluation of excellent was given when the oral instructions were fol-

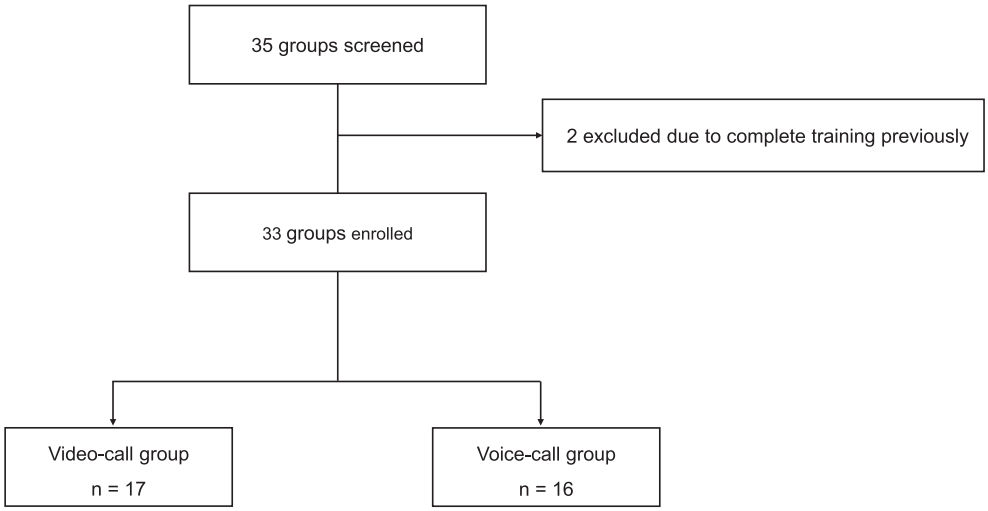

Fig. 2 Patient flowchart

lowed, and all three points were satisfied. An evaluation of acceptable was given when all three points were satisfied, but adherence to oral instructions was not complete. An evaluation of poor was given when at least one of the three points was not satisfied.

The simulations were recorded with fixed video and GoPro cameras (GoPro, Inc., San Mateo, California, USA) attached to the rescuer's head. If the first aid occurred in a blind spot of the fixed video camera, the GoPro video was used to determine whether it was being performed properly.

The primary outcome was defined as receipt of an excellent or acceptable evaluation at the end of the simulation, and the secondary outcomes were receipt of an excellent evaluation and the interval from the start of instruction to the point when first aid was performed correctly.

Statistical Analysis

On the basis of a previous study on opening the airway during CPR[17], we assumed that 59% of simulations in the voice-call group and 95% of simulations in the video-call group would receive an excellent or acceptable evaluation. Therefore, we calculated that the simulation study would need to run 32 simulations to have 80% power to detect differences at a one-sided significance level of 5%.

Continuous variables are expressed as medians and interquartile ranges. The Mann-Whitney U test (two-tailed) was used for two-group comparisons. We compared two groups with an intention-to-treat analysis with the chi-square test or Fisher exact test (two-tailed) for comparing categorical variables, depending on which was more suitable. A p-value of less than 0.05 was considered to indicate statistical significance. All data were analyzed using R version 4.0.4 (The R Foundation for Statistical Computing, Vienna, Austria).

Results

In total, 35 simulations were conducted with 70 students. After excluding two because a student had already completed CPR training for infants, data from 33 simulations were analyzed (**Fig. 2**). There were 17 simulations in the video-call group and 16 in the voice-call group. There were no differences between the two groups (**Table 2**). Among the six participants who self-learned first aid for choking infants, after the first oral instruction, four received a poor evaluation and two received an excellent evaluation.

Video-Call Success Rate

In the video-call group, the call succeeded in 13 (76%) simulations but could not be used in four (24%): in two simulations the video call was connected but the participant did not pick up the mobile phone, in one simulation the caller did not tap on the internet link, and in one simulation the voice call was interrupted by a network failure. In these three simulations, instructions were only provided orally. Among the successful video calls (n=13), an average of 35 s (24-59 s) elapsed from sending the internet link to the successful connection of the video call.

First Aid for a Choking Infant

After the dispatcher provided initial oral instructions in a voice call, the proportion of participants receiving an excellent or acceptable evaluation was not significantly different between the video-call group and voice-call group (41% vs. 50%, respectively; p=0.61) (**Fig. 3**). Ten simulations in the video-call group received a poor

Table 2 Characteristics of voice-call group and video-call group

	Video-call group (n=34)	Voice-call group (n=32)	p value
Age, y; mean (interquartile range)	19 (19-19)	19 (18-19)	0.57
Sex, male; n (%)	27 (79%)	24 (75%)	0.67
Daily smartphone use; n (%)	34 (100%)	32 (100%)	1.00
Learned first aid for choking infant; n (%)	1 (3%)	5 (16%)	0.07
Learned CPR for infant; n (%)	20 (63%)	17 (53%)	0.64
Experience calling emergency services; n (%)	6 (19%)	4 (13%)	0.56

CPR, cardiopulmonary resuscitation

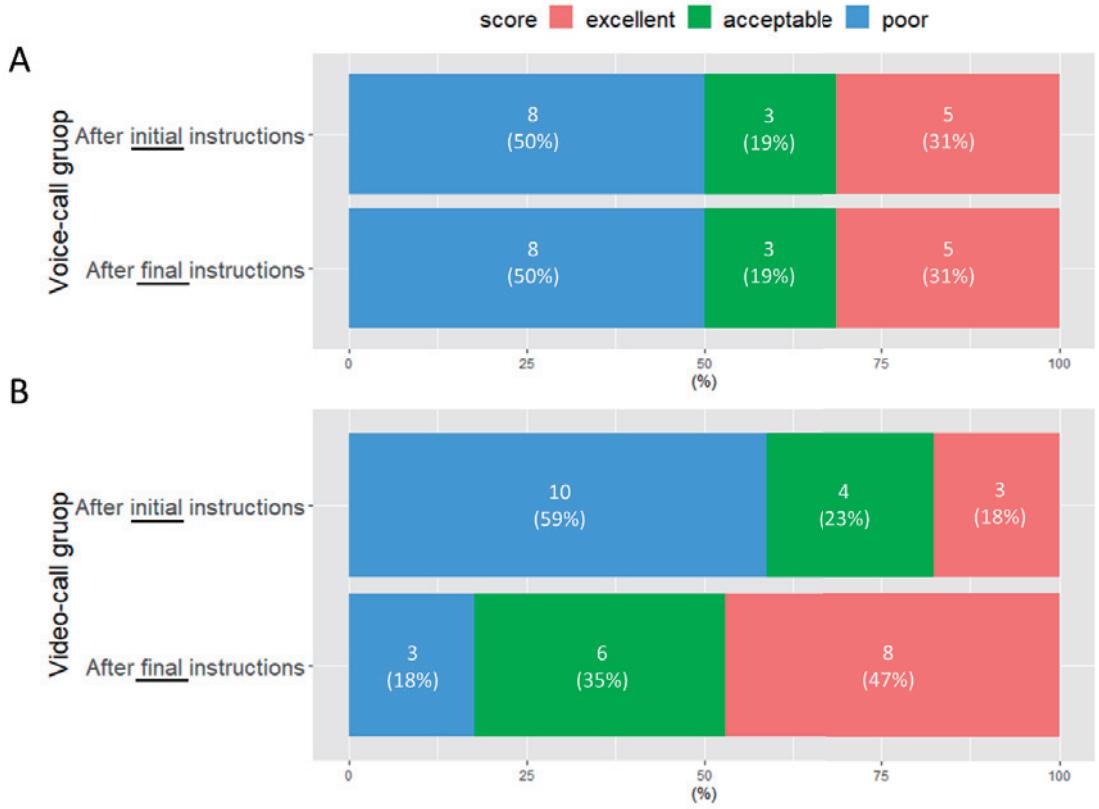

Fig. 3 Evaluation of first aid after oral instructions
(A) Evaluation of first aid for choking after initial and final instructions via voice calls.
(B) Evaluation of first aid for choking after initial and final instructions via video calls.

evaluation after the initial oral instructions, eight successfully transitioned to a video call, and seven of those received an improved evaluation. Thus, after following all instructions, the proportion of participants receiving an excellent or acceptable evaluation was significantly higher in the video-call group than in the voice-call group (82% vs. 50%, p=0.049). There was no significant difference in the proportion of excellent evaluations between the video-call group and the voice-call group (47% vs. 31%, p=0.35).

Interval to the Start of First Aid

The interval from the start of oral instructions to the correct performance of first aid was slightly shorter in the voice-call group than in the video-call group, although the difference was not significant (99 s [70-147 s] vs. 70 s [53-101 s], respectively; P=0.10).

Discussion

In simulations of first aid for choking infants, video calling improved the quality of first aid; the proportion of participants unable to perform it correctly was significantly lower in the video-call group. Few previous studies have described the effectiveness of oral instructions using video calls for first aid beyond CPR[18].

After the initial oral instructions, 55% of the participants did not correctly perform first aid for infants with

FBAO, which suggests that it was difficult to perform a complex procedure correctly with only oral instructions. Most cases improved when the voice call was switched to a video call; however, there was no improvement in the voice-call group after the initial oral instruction, which is a limitation of voice calls. We suggest two possible solutions. First, the dispatcher must be trained to watch and guide the rescuer's actions. Second, improvement is expected when communication is interactive, whereby images or videos are provided to the rescuer.

For CPR, video calls have been reported as better than voice calls for assisting bystanders in airway management and minute ventilation in rescue breathing[17] and in chest compression depth[19], chest compression rate[19–21], position[20,21], and the ratio of chest compressions to artificial respirations[22]. Furthermore, video calls allow the dispatcher to notice important physical findings and changes in the choking person, even if the rescuer is not aware of them. For example, in research on simulated cardiac arrest, more cases of respiratory arrest were recognized in video calls than in voice calls[18,23].

Video calls may delay initiation of CPR. In a previous study of CPR, video calls delayed the start of the procedure by a mean of 31.5 s[24]. In the present study, both groups received audio instruction at the beginning, to avoid a delay in the video-call group. In contrast, if video calls were implemented with the public, the interval until successful initiation of first aid would increase because some study participants succeeded after the video-call was made, thus artificially decreasing their delay. In four cases (24%), the video call did not work as intended and effectively remained a voice call. The participants were all young adults who regularly used smartphones. The rate of video-call failure might be even higher for rescuers not accustomed to smartphones.

This study had some limitations. First, while it was a randomized control trial, neither participants nor reviewers were blinded to the group assignment because the nature of the study made blinding impractical. Second, because these were simulations, the real-world effectiveness of video-call assistance for first aid to choking infants is unknown. While CPR was efficaciously performed in the simulations, we could not investigate other real-world effects, such as survival to discharge and neurological outcomes[25]. Third, we used high-performance smartphones and high-speed communications, which are not always available under the same conditions as in this study. However, in developed countries, the performance of smartphones is rapidly improving; thus, the present conditions will probably be standard in the near future.

Conclusion

In simulations of first aid for choking infants, the proportion of participants unable to perform back blows correctly with video-call dispatcher assistance was significantly lower than with voice-call assistance. This suggests that receipt of oral instructions during video calls improves the quality of first aid for choking infants.

Acknowledgments: This study was funded by the Foundation for Ambulance Service Development. We would like to thank Mr. Shinichi Shikano, Mr. Mitsunaga Hoshi, Mr. Masanori Mitsuhashi, and Mr. Satoshi Harada for acting as dispatchers in the simulations. We also received assistance from the Faculty of Medical Science at Nippon Sport Science University. Ryobi Systems Co., Ltd. provided technical support.

Conflict of Interest: None declared.

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(Received, March 17, 2022)
(Accepted, May 13, 2022)