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A multidisciplinary approach for improving the outcome of out-of-hospital cardiac arrest in South Korea

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Aim: **Direct medical control using video conferencing capabilities of smartphones has never been conducted in out-of-hospital cardiac arrest patients. This study was conducted to investigate the feasibility and treatment effectiveness of real-time smartphone video conferencing calls for the management of out-of-hospital cardiac arrest.**

Methods: **This study was a pre–post-intervention prospective cohort study conducted from January 2013 to July 2015. The intervention was pre-hospital advanced life support under a physician's direction using a smartphone video call.**

Results: **In total, 942 cardiac arrests occurred over the 2-year period; 308 patients were excluded, and 314 (49.5%) and 320 (50.5%) cardiac arrest patients were enrolled during the pre- and post-intervention study periods, respectively. There were 248/320 (77.5%) cases of smartphone video-assisted advanced life support during the post-intervention period. For patients in the pre- and post-intervention groups, the pre-hospital return of spontaneous circulation was 6.7 and 20%, respectively (adjusted odds ratio 3.3, 95% confidence interval 1.6–6.8, $P < 0.01$), and favourable neurological outcomes were ascertained in 1.9 and 6.9%, respectively (adjusted odds ratio 23.6, 95% confidence interval 3.4–164.0, $P < 0.01$). The smartphone voice and video quality were rated 8.5 and 8.2 out of 10, respectively, in physician evaluation, while the overall utility was rated 9.1.**

Conclusion: **We concluded that a multidisciplinary approach including the re-education of basic life support, simulation training for advanced life support, real-time medical direction via video call, and dispatching two teams rather than one team improved the outcome of out-of-hospital cardiac arrest. *European Journal of Emergency Medicine* 27:46–53 Copyright © 2019 The Author(s). Published by Wolters Kluwer Health, Inc.**

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Introduction

The rate of return of spontaneous circulation (ROSC) after out-of-hospital cardiac arrest (OHCA) in South Korea is 3.5 and 20.9% before and after arrival at the hospital, respectively. The survival to discharge rate is 4.4%. Neurological recovery [cerebral recovery category (CPC) 1 and 2], which is the ultimate goal of cardiopulmonary resuscitation (CPR), is only 2.3% [1]. In most Asian countries, including South Korea, basic life support (BLS) is conducted at the scene, and advanced life support (ALS) is conducted after the patient's arrival at the hospital [2].

In some parts of South Korea, a system of dispatching two ambulances was implemented to address the need to reduce lack of personnel during CPR. Emergency physicians provided medical control with mobile phones. However, ALS was not performed at scene since emergency medical service (EMS) providers were only certified in BLS.

Video calls had previously been reported to be useful in dispatcher-assisted CPR [3,4] but had not been implemented to date. To our knowledge, no other studies have reported attempts to provide ALS support via smartphone videos.

This study investigated the feasibility of medical control via smartphone video calls for patients with OHCA. Investigators created a direct, medically controlled environment in which smartphone video calls and Bluetooth earphones were used by EMS personnel to view and listen to guidance from physicians regarding on-scene ALS activities. OHCA outcomes such as the pre-hospital ROSC, survival to discharge rates, and CPC 1 and 2 neurological recovery pre- and post-implementation were compared.

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Methods

Study design and setting

This was a pre-to-post intervention study conducted from January 2013 to July 2015 using prospectively collected data from patients with OHCA in the urban city of Suwon, South Korea (population of 1.2 million people and 121 km^2 of land). The study area is served by a single EMS dispatch centre run by 41 EMTs with 13 ambulances. For this study, the period from January to December 2013 was categorised as the pre-intervention period, January to July 2014 the preparation period, and August 2014 to July 2015 the post-intervention period.

The Korean EMS is a single-tiered system provided by the government. This includes basic to intermediate level emergency medical technicians. The ambulance teams have two or three crew members, including at least one level-1 EMT. The level-1 EMTs corresponds to intermediate EMTs in the US. They are allowed to insert an intravenous catheter and an advanced airway tube under a physician's direct medical control. Additionally, EMTs are allowed to perform BLS in the automatic external defibrillator mode. Finally, EMTs are not allowed to stop resuscitation at the scene unless there is ROSC. However, even if the patient achieved ROSC, he or she must be monitored by the EMTs to identify a subsequent cardiac arrest or the vital signs becoming unstable.

Study patients

Study patients included all EMS-treated OHCA patients older than 18 years transported to the hospital. Patients diagnosed with trauma arrest, poisoning, asphyxia, hanging, or any other causes that were not considered primary cardiac arrest were excluded. Patients with do-not-resuscitate orders and with obvious signs of irreversible death, such as rigor mortis and livor mortis, were also excluded. Pre-hospital terminations of resuscitation was permitted in these cases with the physician's direct medical input.

Education

During the preparation period, training in ALS was given to the EMS personnel and the medical director. The EMS personnel training was performed in two steps: (1) high-quality BLS training, in which level-1 (senior) EMTs taught the level-2 (junior) EMTs and drivers in BLS till they achieved a post-training accuracy of greater than 90% as recorded by the Laerdal Skill Report System [5]; and (2) ALS training via simulation. The EMS personnel participated as teams consisting of two to three members who worked together practising real-life scenarios. In the simulation scenarios, ambulance EMTs were dispatched after receiving a call about a cardiac arrest patient. The medical directors were contacted and prepped. The video link was checked in advance. The ALS protocol and details, such as direction and location of the camera for the video phone call, were evaluated during the simulations. In order to standardise medical control for the use of smartphone video calls for OHCA, 15 emergency medicine specialists were trained. The medical directors received a 1-day training course before the study was initiated. During 1-day traning course, they were educated to instruct EMTs to show ECG rhythm every 2 minutes via video call to the medical directors, insert advanced airway, give epinephrine every 4 minutes and amiodarone after three shocks.

Intervention

If cardiac arrest was suspected, centre dispatcher dispatches the EMS personnel and then EMS personnel directly contacted the medical director in ambulance before arriving on the scene. Two paramedic teams were activated and sent to the scene. Upon arrival, they would rapidly switch to ALS mode using teamwork-based BLS and video medical control. High-quality CPR, cardiac arrest rhythm confirmation, defibrillation, proper drug administration instructions, and advanced airway insertion were advised and performed via video medical control (Fig. 1).

The medical director would decide that a patient should be transferred if asystole and pulseless electrical activity findings were persistent following 20 minutes of ALS [6–8]. After initiating the transfer, the medical director would contact the receiving hospital. The medical director also provided an explanation of the treatment to the patient's companion via video call.

As EMS personnel were unable to share the information to network at the scene, they had written it down on memo. After returning to the fire station, the level-1 EMT who completed the patient's transfer was responsible for entering the information regarding the patient's medical history and initial rhythm after cardiac arrest by hand on the separate form, taking a picture of the document and uploading it to a confidential social networking service (SNS), an online platform where the physicians and EMTs share input about the medical system, within 24 hours. The information shared via SNS allowed the research staff to provide direct feedback to the EMS personnel regarding their CPR performance as well as communication skills with the physicians. In summary, the multidisciplinary approaches introduced in this study and performed on the patients included provision of high-quality BLS, increase in manpower, manual defibrillation, drug administration and advanced airway insertion [9].

Data sources/measurement

All cases of OHCA included in the study during the pre- and post-interventional periods were registered using an EMS run sheet for basic ambulance operational information, the EMS cardiac arrest registry for the Utstein factors, and the OHCA registry for hospital care and survival outcomes. The data for the EMS run sheet and EMS cardiac arrest registry were collected by the EMS providers. The medical records for hospital care and outcomes

Fig. 1

Images captured during videophone-assisted advanced life support. The medical director supervised cardiopulmonary resuscitation using a smartphone video call. The video contains performance of emergency medical technicians surrounding a patient. During chest compression shift, camera angle is adjusted for capturing ECG rhythm.

were abstracted from the OHCA registry by a trained medical doctor specialised in emergency medicine and hired for this study. To collect data on the feasibility of videophone-call-assisted ALS, a satisfaction survey was completed by the 15 emergency medical specialists who participated in the study as soon as possible upon completion of the video medical control (Was this done soon after each ambulance run that was included in the study, or was this completed after the initial training that the 15 specialists had undergone?).

Outcomes

The primary outcomes were the rate of pre-hospital ROSC, the rate of survival at discharge and the frequency of favourable neurological outcomes (CPC 1 or 2). The secondary outcome was the feasibility of videophone-call-assisted ALS.

Statistical analysis

An intention-to-treat analysis was performed for all the cardiac arrests that occurred during the study period. Continuous variables were reported as means and SDs, or medians and interquartile ranges (IQRs), as appropriate. Categorical variables were reported as frequency counts and percentages. Comparisons between groups were performed using student's *t*-tests for continuous variables and Chi-square tests for categorical variables. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using logistic regression analyses to examine the association between the intervention and favourable neurological outcome. Estimated ORs were adjusted for age, sex, place, bystander CPR, witnesses, family response, initial shockable rhythm, response time interval, scene time interval, transportation time interval, pre-hospital advanced airway, pre-hospital epinephrine and post-arrest hypothermia. A P value <0.05 was considered statistically significant; all statistical tests were two-sided. All statistical analyses were performed using Stata version 14 (StataCorp, College Station, Texas, USA).

Ethics

This study was approved by the Institutional Review Boards of the Ajou University Medical Center, the

Catholic University of Korea and Saint Vincent's Hospital. The need for written informed consent was waived, and the Health Insurance Portability and Accountability Act authorisation was granted (AJIRB-MED-MDB-15–245, VC15RIMI0138).

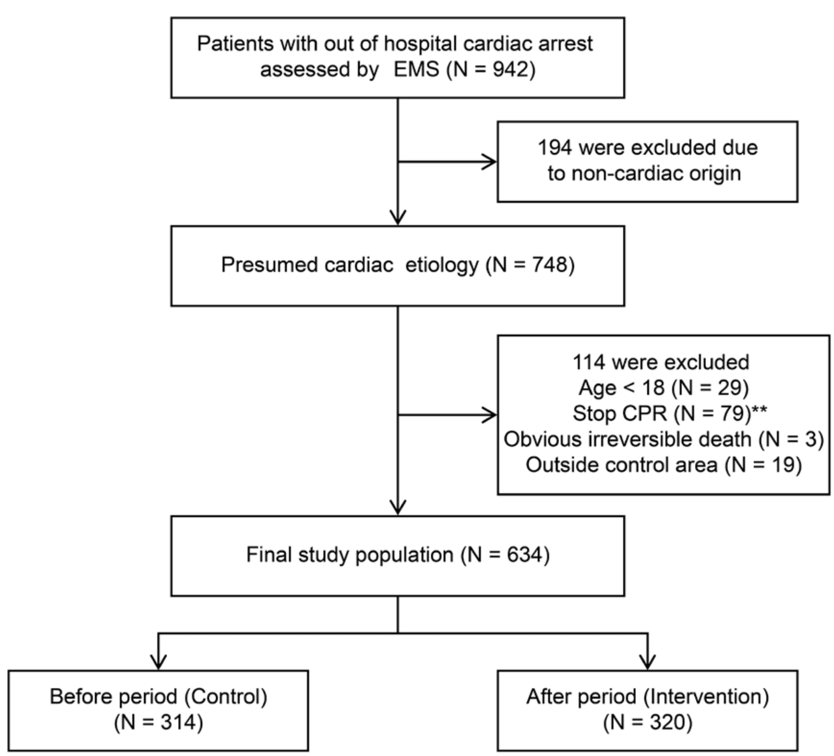
Results

Nine hundred forty-two cardiac arrests occurred over the 2-year study period; 308 patients were excluded, leaving 634 patients for inclusion in our study. During the pre- and post-intervention study periods, 314 (49.5%) and 320 (50.5%) cardiac arrest patients were enrolled in the study, respectively (Fig. 2). There were no significant differences in patient and environmental factors such as sex, mean age, the incidence rate of cardiac arrest in public places, the presence of a witness and initial shockable rhythm rate between participants enrolled in the two study periods ($P > 0.05$). During the post-intervention period, the rates of family response [51.0% (160/314) pre-intervention vs. 61.3% (196/320) post-intervention, $P = 0.01$] and bystander CPR [47.5% (149/314) pre-intervention vs. 60.3% (193/320) post-intervention, $P = 0.001$] were significantly higher (Table 1).

During the pre-intervention period, a phone rather than a video call for medical control through a smartphone was provided in 46 cases (14.6%), while during the post-interventional period, there were 302 (94.4%) cases in which medical control was requested via a phone call and 248 (77.5%) cases in which ALS via a smartphone video call was implemented. Fifty-four patients did not receive this intervention as it had not yet been implemented in their areas of residence. EMS defibrillation was successful in 26 (8.3%) and 50 (15.6%) cases in the pre- and post-interventional periods ($P = 0.004$), respectively. Advanced airway insertion was conducted in 72 (22.9%) and 241 (75.3%) cases in the pre- and post-interventional periods, respectively ($P < 0.001$). Drug administration was performed only during the post-interventional period. The following drugs were administered: epinephrine (n = 202, 63.1%), amiodarone (n = 12, 3.8%), lidocaine (n = 8, 2.5%), sodium bicarbonate (n = 32, 10.0%), and calcium chloride (n = 1, 0.3%).

There were no significant differences between the pre- and post-intervention study periods based on the time that elapsed between the EMS call to the arrival on the scene or the time that elapsed from arrival on the scene to the arrival at the hospital ($P > 0.05$). However, the median time spent on the scene was 10 minutes (IQR 7–15) compared to 27 minutes (IQR 20.5–33.5) in the pre- and post-intervention study periods, respectively ($P < 0.001$).

Fig. 2



Study flow diagram. CPR, cardiopulmonary resuscitation; EMS, emergency medical service. **Stop CPR group includes patients with written do not attempt resuscitation (DNAR) order or guardian's refusal to resuscitate.

Table 1 Baseline characteristics of patients enrolled in the study in the pre- and post-intervention periods (n = 634)

Characteristics	Pre-intervention (January–December 2013) (N = 314)	Post-intervention (August 2014–July 2015) (N = 320)	*P* value
Patient and environmental factors			
Male sex, n (%)	205 (65.3)	213 (66.6)	0.74
Age (y), mean ± SD	66.0 ± 16.1	67.2 ± 16.4	0.33
OHCA in a public place, n (%)	52 (16.6)	54 (16.9)	0.92
Family response to OHCA, n (%)	160 (51.0)	196 (61.3)	0.01
Bystander-witnessed OHCA, n (%)	173 (55.1)	173 (54.1)	0.79
Initial shockable rhythm, n (%)	50 (15.9)	60 (18.8)	0.35
Bystander CPR, n (%)	149 (47.5)	193 (60.3)	0.001
Bystander AED applied, n (%)	8 (2.5)	2 (0.6)	0.05
EMS factors			
Call success for medical direction, n (%)	46 (14.6)	302 (94.4)	<0.001
Video phone call assisted CPR, n (%)	0	248 (77.5)	NA
EMS defibrillation success, n (%)	26 (8.3)	50 (15.6)	0.004
Pre-hospital advanced airway, n (%)	72 (22.9)	241 (75.3)	<0.001
I-gel, n (%)	59 (18.8)	236 (73.8)	<0.001
Endotracheal tube, n (%)	13 (4.1)	5 (1.6)	0.05
Pre-hospital drug administered, n (%)	0	204 (63.8)	NA
Epinephrine, n (%)	0	202 (63.1)	NA
Amiodarone, n (%)	0	12 (3.8)	NA
Lidocaine, n (%)	0	8 (2.5)	NA
Sodium bicarbonate, n (%)	0	32 (10.0)	NA
Calcium chloride, n (%)	0	1 (0.3)	NA
Time between events (min)			
Response time interval (call to EMS arrival on scene), median (IQR)	7 (6–10)	8 (6.5–10)	0.02
Scene time interval, median (IQR)	10 (7–15)	27 (20.5–33.5)	<0.001
Transportation time interval (from scene to hospital)- median (IQR)	7 (4–10)	7 (5–10)	0.63
Total pre-hospital time interval (call to arrival at hospital), median (IQR)	26 (22–31)	43 (35–50)	<0.001
Post resuscitation care			
PCI, n (%)	5 (1.6)	12 (3.8)	0.09
Pacemaker or ICD insertion, n (%)	3 (1.0)	8 (2.5)	0.14
CABG, n (%)	0	1 (0.3)	0.32
Hypothermia therapy, n (%)	19 (6.1)	33 (10.3)	0.05
ECMO therapy, n (%)	5 (1.6)	4 (1.3)	0.72

AED, automatic electrical defibrillator; CABG, coronary artery bypass graft; CPR, cardiopulmonary resuscitation; ECMO, extracorporeal membrane oxygenation; EMS, emergency medical services; ICD, implantable cardioverter defibrillator; IQR, interquartile range; NA, not applicable; OHCA, out-of-hospital cardiac arrest; PCI, percutaneous coronary intervention.

Table 2 Outcomes for patients enrolled in the study during the pre-and post-intervention periods

Outcome	Pre-intervention (January–December 2013) (N = 314)	Post-intervention (August 2014–July 2015) (N = 320)	*P* value	Pre vs. post OR (95% CI)	Pre vs. post [a]AOR (95% CI)
Pre-hospital ROSC, n (%)	21 (6.7)	64 (20.0)	<0.01	3.5 (2.1–5.9)	3.3 (1.6–6.8)
[a]ED ROSC, n (%)[c]	91 (29.0)	58 (18.1)	0.38	0.5 (0.4–0.8)	1.2 (0.8–2.0)
Total ROSC, n (%)	112 (35.7)	122 (38.1)	0.25	1.1 (0.8–1.5)	1.3 (0.8–2.1)
Survival to discharge, n (%)	22 (7.0)	40 (12.5)	0.06	1.9 (1.1–3.3)	2.8 (0.9–8.3)
[b]Functional brain recovery, n (%)	6 (1.9)	22 (6.9)	<0.01	3.8 (1.5–9.5)	23.6 (3.4–164.0)

Total ROSC corresponds to obtaining pre-hospital ROSC or emergency department ROSC.
AOR, adjusted odds ratio; CI, confidence interval; ED, emergency department; OR, odds ratio; ROSC, return of spontaneous circulation.
[a]AOR [the analyses are adjusted for sex, age, place, witness, bystander cardiopulmonary resuscitation, family response, initial shockable rhythm, response time interval (call to EMS arrival on scene), scene time interval, transportation time interval (from scene to hospital)], pre-hospital advanced airway, pre-hospital epinephrine, post-arrest hypothermia (except ROSC variables).
[b]Good functional recovery is equal to cerebral performance category scale 1 or 2.

There were no significant differences between the rates of percutaneous intervention, pacemaker/intracardiac defibrillator insertion, coronary artery bypass graft, targeted temperature management, and extracorporeal membrane oxygenation therapy that was provided after hospital arrival in the pre- and post-intervention study periods ($P > 0.05$).

Study outcomes can be viewed in Table 2. The pre-hospital ROSC rate was 6.7% (21/314) and 20.0% (64/320) in the pre- and post-intervention periods, respectively ($P < 0.01$), while the overall ROSC rate was 35.7% (112/314) and 38.1% (122/320) in the pre- and post-intervention periods, respectively ($P = 0.25$). The survival rate at discharge was 7.0% (22/314) and 12.5% (40/320) in the pre- and post-intervention periods ($P = 0.06$); the adjusted OR (AOR) was 1.9 (95% CI 1.1–3.3). Brain function recovery was experienced in 1.9% (6/314) and 6.9% (22/320) patients in the pre- and post-intervention periods, respectively ($P < 0.01$); the AOR was 23.6 (95% CI 3.4–164.0).

The feasibility results for smartphone video-assisted ALS are presented in Table 3. On a scale of 1–10, the mean scores (±SD) for the overall voice and video quality were 8.5 ± 1.0 and 8.2 ± 1.1, respectively. With the exception of the compression depth assessment (3.2 ± 1.4), the mean scores for the remaining factors investigated ranged between 7.5 and 9.5. The score for the overall utility of videophone-assisted ALS was 9.1 ± 0.7.

Discussion

To increase the survival rate of OHCA patients, many factors must be processed simultaneously. In particular, CPR must be continuously conducted without stopping for patient transfer or ALS [10–12]. Furthermore, applying ALS at the scene rather than rapidly transferring the patient to the hospital to perform ALS can prevent the degradation of CPR quality during the transfer. South Korea's EMS system entails complex procedures that do not allow EMTs to independently inject epinephrine or provide manual defibrillation without direct authorization by a doctor. This study investigated the feasibility of medical control via smartphone video call for patients with OHCA in order to mitigate this challenge.

Previous studies that have investigated the impact of ALS at the scene have shown varied results depending on the EMS conditions, thus giving rise to some controversy [13–17]. Stiell *et al.* [15] showed that early CPR and early defibrillation might be more important than early advanced care in OHCA. On the other hand, a recently published meta-analysis reported that physician-guided CPR increases the survival rate of OHCA patients when compared to CPR given by a single paramedic (OR 2.03, 95% CI 1.477–2.791) [18]. One potential reason for this outcome is that the participation of a physician increases compliance with CPR guidelines, therefore reducing hands-off time.

Table 3 **Confidence score for determining cardiopulmonary resuscitation performance**

Question	[a]Scores (mean ± SD)
Overall voice quality	8.5 ± 1.0
Overall image quality	8.2 ± 1.1
Chest compression fraction[b]	7.5 ± 1.2
Chest compression depth	3.2 ± 1.4
Chest compression location	7.6 ± 1.2
BVM ventilation rate	8.7 ± 1.1
BVM ventilation volume	8.4 ± 1.3
ECG monitor	9.5 ± 0.8
IV catheterization and drug administration	9.2 ± 0.6
Overall utility	9.1 ± 0.7

BVM, bag-valve mask; ECG, electrocardiogram; IV, intravenous.
[a]Scores were measured on a 10 point likert scale from 1, indicating strongly disagree, to 10, indicating strongly agree.
[b]The chest-compression fraction is the proportion of each minute during which compressions were given.

In this study, we reported that high-quality CPR, equivalent to that suggested by the guidelines, can be provided through direct medical control over a smartphone video call. Physicians not only instructed the EMTs to perform ALS but also participated in the entire resuscitation effort through a real-time smartphone video call upon EMS arrival on the scene. CPR performance and ALS algorithms can be actively monitored and directed, with the possibility of a physician making on-scene recommendations depending on the changes in resuscitation and the patient's clinical response. The feasibility evaluation surveys completed by the physicians who participated in this study indicated that the compression depths were assessed as unsatisfactory; however, the remainder of the factors evaluated had a mean rating of seven or higher. Voice and video quality (communication environments) were scored as satisfactory. CPR performance, including chest compression fraction and location, ventilation volume and rate, IV catheterisation and drug administration, could be well evaluated using the video information. The overall utility of direct medical control using the smartphone video call was given a mean score of 9.1 out of 10 possible points. This high score was probably in part due to the reliable, stable, and fast wireless information technology platform in South Korea.

During the pre- and post-intervention study periods, the pre-hospital ROSC (AOR 3.3, 95% CI 1.6–6.8) increased; however, there was no difference in the emergency department ROSC (AOR 1.2, 95% CI 0.8–2.0) and total ROSC rate (AOR 1.3, 95% CI 0.8–2.1). Survival rate at discharge (7.0% pre- and 12.5% post-intervention) increased, but this was not a statistically significant difference. However, brain function recovery rate (1.9% pre- and 6.9% post-intervention) increased significantly. After adjusting for Utstein variables, the AOR of the brain function recovery was 23.6 (95% CI 3.4–164.0), showing a greater impact on the central nervous system. This might be due to the fact that when compared to previous study results, the time from cardiac arrest to ROSC was shortened and optimised through high-quality ALS provided on the scene [8,19]. The treatment of patients during transport affects the reduction in CPR quality and survival rate [20,21].

EMTs have limitations in their work boundaries in Korea. I-gel insertion, for example, can only be performed by level-1 EMTs if under remote direct medical control. During the pre-phase, only one team of EMTs were dispatched to the scene. They had manpower shortage and could not both treat patients and receive medical control. In the pre-phase, i-gel insertion was performed only when this situation (18%) was resolved. In the post-phase, the manpower shortage was resolved by dispatch of two teams, and direct medical control using smartphone was available.

In summary, multiple factors were influence result of this study such as high-quality BLS training, increase in manpower, manual defibrillation, drug administration, advanced airway insertion (Table 4) [9].

This study showed an increased survival rate. However, it was not statistically significant but showed close proximity. Further studies are needed to determine whether these positive effects are due to the introduction of ALS (e.g. drug administration, advanced airway) on the scene, the Hawthorne effect, or the provision of BLS training within a team environment. Regardless, direct medical control of the EMS personnel by physicians trained to use smartphone video is feasible for patients with OHCA. This system has been shown to improve the pre-hospital ROSC and cerebral function recovery rate. Smartphone video-assisted, direct medical control has been shown to be a satisfactory method of introducing ALS to EMS providers. South Korea's Ministry of Health and Welfare has recognised this achievement and has approved the operational components of this study for implementation. The ministry has begun the funding of this intervention in seven different areas of the country covering 11 million people since the completion of this study. In fact, preparations are being made for the expansion of this intervention into a nationwide effort.

Limitations

As this was a pre- and post-intervention study, there is a possibility that the results could have been affected by confounding factors not intended or measured by the investigators. Thus, there is a possibility that the increased rate of awareness of cardiac arrest and bystander CPR was induced by the monitoring of the control room staff during the study period. To address this limitation, these variables were adjusted for during analysis.

As various changes were made simultaneously during the post-intervention period, including high-quality CPR, videophone use, intervention by a physician, increase in the duration of time on the scene, and introduction of ALS before the patient's arrival at the hospital, the effects of individual modalities could not be measured. However, considering that the successful connection of the different stages is more important than single-factor intervention from the viewpoint of the survival chain, the system changes that occurred during the post-interventional period were measured as an exposure variable.

Table 4 Summary of intervention

	Pre-intervention	Post-intervention
EMS crews	3	6
Medical control	Not-available	By videophone
Guideline for scene time	At least 5 min	No limit
Defibrillation	Automatic	Manual
Drug administation	Restricted	Only under direct medical advisement
Airway	By bag-valve mask	Advanced airway

EMS, emergency medical service.

Therefore, intention-to-treat analyses were performed for all of the cardiac arrests that occurred during that period.

We cannot estimate a pure effect of direct medical control using video phone because we cannot adjust variables that cannot be quantified. However, to establish optimal EMS using video phone, improvement of multiple bundle of care that makes effective interaction between physician and EMS personnel should be needed. We think this study is not to determine the pure effect of video call but as a study to build a new EMS system using video call.

Finally, the sample size was small since this study was performed in a city with a small population. To generalise the effect of this intervention, further evaluations in other regions with different geographic and social conditions, as well as EMS settings, are required.

Conclusion

In this study, we concluded that a multidisciplinary approach including the re-education of BLS, simulation training for ALS, real-time medical direction via video call, and dispatching two teams rather than one team improved the outcome of OHCA.

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Conflicts of interest

There are no conflicts of interest.

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