

Telephone CPR: Current Status, Challenges, and Future Perspectives

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Abstract: With each successive update of the cardiopulmonary resuscitation (CPR) guidelines, the role of dispatchers in sudden cardiac arrest (CA) has grown. Dispatchers instruct callers in how to perform CPR until the arrival of emergency medical service (EMS) professionals. This is widely known as telephone CPR (TCPR) or dispatch-assisted CPR (DACPR). Studies have shown the efficacy of TCPR in increasing the survival rate of sudden CA. The TCPR process, however, is challenging and needs to be constantly evaluated and refined in order to improve the survival rate of sudden CA victims throughout the world. In this review article, the current status, challenges, and future perspectives of TCPR are discussed with a view to providing a research foundation from which to launch further studies into the effective role of dispatchers in sudden CA.

Keywords: out of hospital cardiac arrest, telephone cardiopulmonary resuscitation, emergency medical dispatcher

Introduction

Sudden out-of-hospital cardiac arrest (OHCA) is a leading cause of death in many countries. The incidence is reported to be 84 to 110.8 per 100,000 people in Europe and the United States.^{1,2} However, the rate of survival with favorable neurological outcomes rarely exceeds 10%.³⁻⁵ Bystander cardiopulmonary resuscitation (BCPR) before emergency medical services (EMS) arrival can more than double the chance of survival from OHCA.⁶ The significance of early BCPR is well established and the probability for survival decreases by 7% to 10% per minute if BCPR is not performed.⁷ Bystanders, however, often hesitate to start CPR, because they are not sure if the patient is in cardiac arrest and are not confident to perform CPR. The frequency of BCPR has been reported to be as high as 97.9%, but also as low as 5.5% in independent studies and is most commonly reported at around 40%.^{1,3,5,8} Emergency medical dispatchers can play a critical role in maximizing the frequency of BCPR before EMS arrival. Dispatchers can recognize CA and assist emergency callers to perform CPR via telephone. This procedure is called telephone CPR (TCPR) or dispatch-assisted CPR (DACPR). The impact of TCPR was already illustrated in the 1980s by Eisenberg et al.⁹ According to the literatures, TCPR accounts for the majority of BCPR.¹⁰⁻¹² This life saving procedure is now integrated in the international resuscitation guideline.¹³ By identifying CA via telephone and assisting callers to initiate immediate CPR, dispatchers strengthen the chain of survival.

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How Dispatchers Identify CA?

When lay people encounter a cardiac arrest case, they usually call regional emergency numbers and ask EMS to dispatch an ambulance. Call takers immediately dispatch ambulances and identify the exact location of emergency. In addition to this process, dispatchers confirm the cardiac arrest from all the various information reported by callers. Identification of CA is a fundamental part of the TCPR process. Emergency callers report various information concerning the victim such as unconsciousness, not breathing, ill facial color, cold body, and the location where they found the victims.¹⁴ Several key pieces of information can indicate a possible cardiac arrest. However, some of this information is complex and can be misleading.^{14,15}

The recommended protocol to identify CA is called 2-question protocol.¹⁶ This standardized CA identification procedure is: 1) to assess victim's responsiveness and 2) to make sure that the victim is not breathing normally. The sensitivity and specificity of this protocol for CA identification is reported to be 38–90% and 95–99%, respectively.^{9,17-21} With this protocol, there is a chance that dispatchers misdiagnose non-CA victims such as stroke, drug intoxication or syncope with CA.^{22,23} However, there is currently no other superior protocol available that can help dispatchers identify CA more correctly and immediately, which explains why this 2-question protocol has been adopted in many regions around the world.

When following this protocol, confirming “not breathing normally” can be surprisingly challenging.

Agonal Respiration

There are many obstacles to the dispatchers identifying CA during conversations with callers. The major and critical one is the agonal respiration that may appear right after the victim collapses. Agonal respiration is a common mammalian pre-terminal phenomenon in response to medullary hypoxia. This abnormal breathing appears soon after CA and disappears within a short period of time.^{24,25} Agonal respiration is an early sign of CA and studies indicate it is significantly associated with a high likelihood of initial shockable rhythm, which may contribute to good neurological outcomes.²⁵⁻²⁷ Lay rescuers, however, usually do not consider this movement as a sign of CA and report that CA victims with agonal respiration are unconscious, but still breathing.

Callers also describe this form of abnormal breathing as: gasping, snoring, or moaning.^{15,28} Descriptors for agonal respirations often vary depending on the culture or language. Each local agency should investigate how lay people in the

community are likely to describe agonal respiration and try to improve CA identification based on these results. Sometimes agonal respiration can be heard in the background of the call and may help dispatchers identify CA immediately. However, it often delays CA identification.²⁸ While dispatchers are required to identify CA from various breathing styles, according to the literature they often miss the opportunity to identify CA victims with agonal respirations.²⁹⁻³¹

Other Obstacles to CA Identification

Other obstacles such as the callers who are upset, hang up the phone, and callers who have left the side of the victim also impede dispatch CA identification.³²⁻³⁴ The frequency of these obstacles varies between CAs which occur at private residences and those which occur in public locations. Callers with victims at private residences are more often upset than those in public places.³⁵ Dispatchers often need to calm the callers in order to grasp the patient's condition. On the other hand, in CA cases in public locations, dispatchers often face difficulties in obtaining information about the patient, because callers often are not by the victims' side when they make the call. In some cases, the caller has had no contact with the victim and was simply requested to make the emergency call.³⁵ Language barrier is another obstacle in some nations. This barrier can significantly delay the whole TCPR process.^{34,36}

Recent study done by Stangenes et al showed that caller descriptions of victim's medical history or chief complaints (eg, chest pain, stroke, etc.) can significantly delay dispatcher's identification of CA when compared to descriptions of the sign or symptoms (eg, not breathing, collapsed, turning blue, etc.).³⁷

At present, the obstacles described above are quite difficult to overcome, and there is a real need to identify new and effective measures to overcome these barriers in the future.

Improving Identification of Agonal Respiration

Generally, dispatch training includes interview techniques, computer training, medical knowledge and CPR certification. In addition to this training, educating dispatchers specifically with regard to agonal respiration through lectures can improve CA identification.^{31,38} Simulation training can also make a big difference.^{39,40} Dispatchers know that CA identification is critical, but specific education and scenario practice for CA identification, especially agonal breathing, can fill their knowledge gaps. More importantly, feedback

and systematic reviews of CA dispatch calls can continuously improve the CA identification rate.^{15,21}

Dispatch Instruction for CPR

Once dispatchers identify CA, they instruct callers to perform CPR. The various versions for CPR instruction steps described in the literature are quite similar.^{16,41,42} A standard sample of the steps for chest-compression only CPR is shown in **Box 1**.

Nowadays, activating the speaker function of the phone has become common, reflecting the smartphone era.^{43,44} With this speaker function, callers can follow the dispatcher's instruction with their hands free.

During their instructions, dispatchers need to encourage callers to perform CPR until EMS arrival, which generally takes not less than 6 to 8 minutes.^{8,45,46} Continuing push hard and fast chest compressions for this time period is quite hard, even for young callers.⁴⁷

High-quality chest compression is essential in obtaining better outcomes of OHCA. However, it is currently impossible to monitor how well callers are performing CPR. Still, continuous verbal support from dispatchers has been shown to improve the quality of BCPR until EMS arrival.⁴²

Instruction of Chest Compression Only CPR versus Conventional CPR

As the CPR guidelines have been revised, chest compression only CPR has become popular and has contributed to an increased frequency of bystander CPR. Many previous studies showed that both CPR techniques were equivalent in terms of prehospital return of spontaneous circulation (ROSC), survival to hospital discharge, and favorable neurological outcome.^{48–50} The 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendation emphasize that dispatchers

Box 1 Example of Telephone CPR Steps

Place the person flat on his/her back on the floor.
 Kneel by the person's side.
 Put the heel of your hand on the center of the person's chest.
 Put your other hand on top of that hand.
 Keep your arms straight and lock your elbows
 Push down with the heel of your hand at least 2 inches.
 Push at the speed of 100 pushes per minute.
 Make sure chest comes all the way up between pushes.
 Count out loud.
 Keep pushing until help takes over.

Abbreviation: CPR, cardiopulmonary resuscitation.

should provide instructions of compression only CPR for adults with suspected cardiac arrest.⁵¹ Yet, there are debates over which CPR method is better than the other.^{52–56} Various studies showed that conventional CPR is much better than compression only CPR for CA victims with non-cardiac origins.^{52–54} It is, however, almost impossible to identify the cause of cardiac arrest via emergency call. T CPR programs should adopt either one of the CPR instructions based on the presumed etiologies, distribution of CPR education, rescuers' familiarity with CPR and the bystander CPR rate in the community. In Japan, many regional T CPR programs have adopted compression only CPR for untrained lay rescuers and this now accounts for the majority of bystander CPR.⁵⁷

Telephone CPR for the Child

Even for pediatric cardiac arrest victims, T CPR can significantly increase bystander CPR and contribute to improvement in both survival and favorable neurological outcome.^{58–60} The debate between compression only CPR and conventional CPR is more relevant in this population. Since the major etiology of cardiac arrest is non-cardiac such as acute respiratory compromise or drowning, it is relevant that chest compression with rescue breathing can contribute more than compression only CPR to survival and favorable neurological outcome.^{52,53,60,61} However, the impact of both CPR techniques are equivalent for those pediatric arrests of cardiac cause.^{52,53} Again, dispatchers need to choose which CPR techniques to use based on both the presumed cardiac etiology and rescuers' familiarity with CPR techniques.

Obstacles to Providing CPR Instruction

Frequently cited obstacles to the effective provision of CPR are callers' physical disability or refusal to perform CPR.^{35,62} The victims' physical position may also impede CPR. If the victim is on sofa or bed, callers need to move the victim onto a hard-flat surface such as the floor before starting CPR. Langlais reported that these obstacles appeared in 26% of CA calls and caused an average delay of more than 100 seconds to the start of CPR when compared to CA cases with no obstacles.⁶³

Adverse Effects of T CPR for Non-CA Victims

T CPR CA identification protocol is quite simple. Thus, it is quite often that unconscious victims who are not in CA are misjudged to be in CA and receive chest compressions.^{22,23,30}

However, chest compressions on these unconscious non-CA victims are reported to be quite safe. White et al investigated 247 unconscious non-CA victims who received CPR and reported that their most frequent complaint was chest discomfort, and rib fractures.²² Severe injuries rarely occur due to CPR on non-CA victims. If the victim is not in CA, he/she may open their eyes or try to remove rescuers hands from their chest soon after compressions are started and the damage can be quite minor. As guidelines state, no CPR for CA is more dangerous than CPR for Non-CA victims.¹³

The Impact on Survival

Several population-based studies have shown that introducing TCPR can increase the rate of BCPR and improve survival with favorable neurological outcome of CA.^{11,64-67} TCPR is reported to be independently associated with functional neurological outcomes. It is reported that its impact on survival is comparable to BCPR without dispatch CPR instruction.^{11,64-67} A study done by Wu et al reviewed 2310 adult OHCA with cardiac origin over 130 EMS agencies in Arizona and reported that TCPR was independently associated with favorable neurological outcome when compared to OHCA victims with BCPR without dispatch instruction (odds ratio: 1.58 and 1.56, respectively).¹¹ Ro et al reported that the impact of TCPR was much greater than BCPR without dispatch assistance in terms of favorable neurological outcome (odds ratio: 1.58 vs 1.28).⁶⁷ Although many studies reported that TCPR is an effective approach to improve CA survival, most of these are observational studies, and no randomized study has been performed yet. On the other hand, some studies reported that TCPR's effect is similar to no BCPR and have failed to show any positive effect.⁶⁸⁻⁷⁰ It is therefore very important to focus on what leads to this difference between studies in order to improve CA survival in all communities.

TCPR Process Analysis

In order to improve the quality of TCPR, it is necessary to measure the key TCPR metrics and adjust the delivery of TCPR in order to improve these values. There is, however, no universal standardized key metrics for TCPR. Key TCPR metrics proposed or recommended in literature are shown in Table 1.

Among the literature, the proportion of CA recognition by dispatchers ranges from around 70% to 75%.^{12,45,71,72} The proportion of TCPR initiation, however, drops down to 5% to 50%.^{12,45,71,72} Studies reported that time from call receipt to dispatch CA identification and start of CPR instruction is approximately 60 and 150 seconds.^{28,32,45} The time from the

Table 1 The Performance of Telephone CPR

1) Process Analysis	
Percentage of CA identification out of TCPR indicated calls	
Percentage of TCPR instruction out of TCPR indicated calls	
Percentage of TCPR initiated out of TCPR indicated calls	
2) Time Analysis	
Time from call receive to dispatch identification of CA	
Time from call to start of TCPR instruction	
Time from call to first chest compression	

Abbreviations: CA, cardiac arrest; TCPR, telephone cardiopulmonary resuscitation.

bystander initiating the call to the first chest compression also varies widely. It is reported to be 180 seconds to over 5 minutes.^{28,32,45,72} Assessing and improving local TCPR with these clearly measurable metrics will contribute to a high-performance TCPR and an improved CA survival rate.

TCPR Education for Lay Rescuers

The survival rate of sudden CA is a quality indicator of how efficiently emergency systems are working in the communities. This system is comprised of not only EMS and health care providers, but citizens who also play an important role. CPR training courses are usually available in many communities, and citizens usually have at least one chance to learn CPR in their lives. For citizens, however, it is quite difficult to maintain CPR skills, which usually decay after training.⁷³ Therefore, dispatchers play a big role in the EMS prearrival period, and lay rescuers expect a lot from dispatchers in helping them perform CPR correctly.⁷⁴ In order to familiarize citizens with TCPR, training courses which include the TCPR process are worth trialing.⁷⁵

Quality Improvement Metrics for TCPR Program

In order to improve the TCPR program in the community, several key metrics should be monitored. A policy statement for TCPR from the American Heart Association⁷⁶ recommends several action items: designating a medical director, evaluating how dispatchers correctly identify CA cases, measuring the time intervals of TCPR process, percentage of TCPR provision out of all OHCA cases, education in TCPR for dispatchers, and introducing a continuous quality improvement process. The policy statement also puts emphasis on encouraging the outstanding individuals who provide TCPR at exceptional level.

Future Perspectives

The new Utstein guideline has been updated and now recommends the collection of data showing whether dispatchers suspect CA or not as a core data metric.⁷⁷ It is likely that the data for dispatch CA identification will soon become a quality indicator for CA survival in each community. Furthermore, standardized TCPR process analysis including the above mentioned TCPR key metrics will enable each community to compare its performance to others and to enhance its impact on survival outcomes.

In future, technological innovations can be a game changer in TCPR. Back in the 1980s, TCPR was performed through wired landlines. In this smartphone era, callers can transfer visual information of the CA to a dispatch center which may help dispatchers identify CA. Smart devices may also in the future transfer information regarding BCPR quality such as depth and rate of chest compressions so that dispatchers can support high-performance CPR.^{78–80} Although these technologies are still at the experimental level, they will surely change TCPR significantly in the near future.

Conclusions

TCPR plays a major role in improving the survival of CA victims. In many regions, TCPR has been introduced and the rate of bystander CPR has been successfully improved. However, this on its own is not enough, in the future not only the frequency, but also the quality of TCPR will need further investigation. It is critical to measure TCPR metrics, improve them, and deploy high-performance TCPR.⁷⁶ As we head into an unprecedented era of connectivity, it is clear that while there are still unresolved issues for TCRP that need to be addressed, TCPR will evolve further and save sudden CA victims in many regions.

Disclosure

The authors report no conflicts of interest in this work.

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