Resuscitation 82 (2011) 1490–1495

Contents lists available at SciVerse ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Review article

In patients with out-of-hospital cardiac arrest, does the provision of dispatch cardiopulmonary resuscitation instructions as opposed to no instructions improve outcome: A systematic review of the literature☆

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ARTICLE INFO

Article history:
Received 11 February 2011
Received in revised form 17 August 2011
Accepted 1 September 2011

Keywords:
Heart arrest
Cardiopulmonary resuscitation
Telephone instruction
Dispatcher

ABSTRACT

Context: Early bystander cardiopulmonary resuscitation (CPR) provides an essential bridge to successful defibrillation from sudden cardiac arrest (SCA) and there is a need to increase the prevalence and quality of bystander CPR. Emergency medical dispatchers can give CPR instructions to a bystander calling for an ambulance enabling even an inexperienced bystander to start CPR. The impact of these instructions has not been evaluated.
Objectives: To determine if, in adult and pediatric patients with out-of-hospital cardiac arrest, the provision of dispatch CPR instructions as opposed to no instructions improves outcome.
Methods: Two independent reviewers used standardized forms and procedures to review papers published between January, 1985 and December, 2009. Findings were peer-reviewed by the International Liaison Committee on Resuscitation.
Data synthesis: We identified 665 citations; five met the inclusion criteria. One retrospective cohort study reported improved survival with dispatch CPR instructions than without it. Three studies, two observational and one with retrospective controls showed trends toward increased survival after dispatcher-assisted CPR was implemented and one showed trend toward decreased survival. There were no randomised studies addressing the topic. No studies addressing dispatch CPR instructions in the pediatric population were found.
Conclusion: There is limited evidence supporting the survival benefit of dispatch-assisted CPR instructions. All studies comparing survival outcomes when CPR is provided with or without the assistance of dispatch-assisted CPR instructions lack the statistical power to draw significant conclusions. Since it has been demonstrated that such instructions can improve bystander CPR rates, it is reasonable to recommend they should be provided to all callers reporting a victim in cardiac arrest.

Contents

☆ A Spanish translated version of the abstract of this article appears as Appendix in the final online version at doi:10.1016/j.resuscitation.2011.09.004.

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doi:10.1016/j.resuscitation.2011.09.004

1. Introduction

In the European population, every year approximately 275,000 persons experiencing a cardiac arrest are treated by EMS, with 29,000 (10.7%) persons surviving to hospital discharge.[1] Early, i.e., before EMS arrival, bystander-initiated CPR has been shown to increase survival significantly[2–4] and this is believed to be because bystander CPR prolongs the electrical or shockable phase of ventricular fibrillation.[5,6] The benefit of bystander CPR seems to exist within a rather narrow time window to be most effective. It must be started within minutes from the moment of collapse and the earlier the bystander CPR starts the better the outcome.[7]

Dispatch CPR instructions via telephone was first conceived in the early 1970s.[8] Emergency medical dispatchers are crucial in supporting and giving CPR-instructions to a bystander calling for an ambulance, enabling even an inexperienced bystander to start CPR.[9,10] Dispatcher-assisted CPR has been shown to improve the rates of bystander CPR in the community.[10–12] Simulation studies suggest that bystanders without former CPR training who receive dispatcher-assisted instructions show comparable CPR skills to previously trained persons, although more time elapses before initiation of CPR for the untrained group.[9] About 50–83% of cardiac arrest cases are identified by dispatchers[13–15] and if they identify cardiac arrest it is associated with increased survival.[16,17]

For adult and pediatric patients with out-of-hospital cardiac arrest (OHCA) we sought to determine if the provision of dispatch CPR instructions as opposed to no instructions improves outcome.

2. Methods

The systematic review was performed in accordance with the International Liaison Committee on Resuscitation (ILCOR) 2010 evidence evaluation process. Review of the search strategy and findings were conducted by the worksheet evaluation experts.[18]

2.1. PICO question

To address the PICO (patient/population, intervention, comparator, outcome) question, this review sought to identify evidence that:[19] in adult and pediatric patients (P) with out-of-hospital cardiac arrest (OHCA) the provision of dispatch CPR instructions (I) as opposed to no instructions (C) improves survival (O)?

2.2. Search strategy

The Cochrane database of systematic reviews was searched using the terms “cardiopulmonary resuscitation” and “dispatch”. The Pubmed, EmBASE, Google Scholar and Scopus databases were searched using the terms “pre arrival”, “dispatch”, “instruction”, “cardiopulmonary resuscitation”, “heart arrest”, “death”, “sudden”, “cardiac”, “outcome”, and “telephone CPR”.

2.3. Study selection

We restricted the review to studies characterized by our eligibility criteria including human, all age groups, cardiac arrest outside hospital, reporting on dispatcher-assisted CPR and effect on survival. The titles of articles were reviewed by two reviewers (MC and JD) for relevance. Articles with a content clearly unrelated were discarded. The abstracts of the remaining articles were then reviewed and relevant studies identified for detailed review of the full manuscript. Where disagreement existed between reviewers, a discussion and a consensus was reached under the supervision of the ILCOR task force. Before finalising the review an expert specifically appointed by ILCOR examined the search to identify any additional articles not captured by the main search strategy.

2.4. Quality assessment

Studies were reviewed in detail and classified by level of evidence (LOE) (Table 1) and quality (rated good, fair or poor) according to definitions provided by ILCOR. Studies were further classified according to whether they were opposing, neutral or supportive regarding the benefits of the use of dispatcher-assisted CPR.[18]

2.5. Final treatment recommendation

The final treatment recommendation is a consensus of several discussions among the ILCOR BLR Task Force and also the consensus meeting in Dallas February 2009 with all work sheet authors.

3. Results

3.1. Literature search results

The search strategy was completed in December 2009. Of 663 potentially relevant papers, 101 were retrieved using predetermined selection criteria; 79 of those were rejected based on manuscript title and abstract. For a more detailed evaluation, we used the same criteria for the full-text review of 22 papers. Of these, 17 were excluded as clearly not relevant. Further inspection of the remaining papers revealed five studies that met our inclusion criteria (Fig. 1). The most usual reasons for exclusion were that the study looked at a simulated situation with a manikin or it did not address patient outcome after dispatcher-assisted CPR.

3.2. Study characteristics

The characteristics for the five studies included in this systematic review are reported in Table 1. All studies were published in English and three were generated from United States, one from

Table 1
Summary of included studies evaluating if the provision of dispatcher-assisted CPR improve outcome.

Article (Reference number)	Quality (Level of evidence)	Survival when CPR instructions are given by dispatchers n (%)	Survival when CPR instructions are not given by dispatchers n (%)	Survival with no bystander CPR n (%)	Study population	End point	Design
Kuisma et al. (2005) [17]	Fair (3)	53/123 (43.1)	72/223 (31.7)	–	Patients with VF only	Hospital discharge 1997–2002	Retrospective cohort
Rea et al. (2001) [21]	Fair (3)	283/1867(15.1)	470/2193 (21.4)	361/3205 (11.3)	Adult, presumed cardiac origin	Hospital discharge 1983–2000	Retrospective cohort
Eisenberg et al. (1985) [20]	Fair (3)	12/58 (21)	21/85 (24)	15/112 (13)	Presumed cardiac origin	Hospital discharge 1981–1982	Before-after a T-CPR training program
Culley et al. (1991) [10]	Fair (3)	Ambulance arrived *(38) <4 min *(50) >4 min	Ambulance arrived *(32) <4 min *(24) >4 min	–	VF only	Hospital discharge 1976–1981 1982–1988	Before-after a T-CPR training program
Vaillancourt et al. (2007) [11]	Fair (3)	7/234 (3)	14/295 (4.8)	–	Presumed cardiac origin	Hospital discharge 2002–2003	Before-after a T-CPR training program

CA, cardiac arrest; VF, ventricular fibrillation; T-CPR, telephone assisted cardiopulmonary resuscitation. Persons who experienced an arrest after the arrival of EMS were excluded in all studies. ILCOR levels of evidence for therapeutic interventions: LOE 1, randomised controlled trials (or meta-analyses of RTC's); LOE 2, studies using concurrent controls without true randomisation (e.g. "pseudo"-randomised) (or meta-analyses of such studies); LOE 3, studies using retrospective controls; LOE 4, studies without a control group (e.g. case series); and LOE 5, studies not directly related to the specific patient/population (e.g. different patient/population, animal models, mechanical models, etc.)
* Absolute numbers were not reported.

Canada and one from Finland. There are no published randomised trials addressing the aim for this review.

3.3. Main study results

Detailed characteristics on the interventions, population, and outcome measures used by the selected studies are presented in Table 1. Findings are synthesized and presented by themes in the following sections.

3.3.1. System wide effects of survival in relation to dispatcher-assisted CPR

Three studies described the effect on survival after implementation of dispatch CPR instruction programs.[10,11,20] Two studies reported survival at discharge and were performed in King County, WA, USA; Cardiac arrest was studied for 20 months (years 1981 and 1982) and survival to discharge before training was 6% (1/17) and after training it was 21% (12/58).[20] Culley and colleagues showed in a VF-only study with historical controls (years 1976–1981 and 1982–1988) that when EMS arrived at the scene within 4 min, the survival was 32% before and 38% ($p = 0.9$) after implementation of a dispatcher-assisted CPR program. When EMS arrived >4 min, the survival was 24% versus 50%, $p = 0.3$.[10] In another study a decreased overall survival (including all rhythms) was seen after implementation of a dispatcher-assisted CPR program. From 4.8% in the control period to 3.0% after a telephone-CPR program was implemented.[11]

3.3.2. Reported impact as a result of CPR instructions

Rea et al. reported on a retrospective, observational study (years 1983–2000, $n = 7265$) that assessed the association between survival to hospital discharge and three distinct adult CPR cohorts: (a) no bystander CPR before EMS arrival, (b) bystander CPR requiring dispatch CPR instructions, and (c) bystander CPR without dispatch CPR instructions. Using no bystander CPR as the reference group, the multivariate adjusted odds ratio of survival was 1.45 (95% [CI] 1.21, 1.73) for bystander CPR with dispatcher assistance and 1.69 (95% [CI] 1.42, 2.01) for bystander CPR without dispatcher assistance.[21] In a retrospective observational study from a VF-only cohort study from Helsinki, Finland survival to discharge when dispatcher-assisted CPR was given was 43.1% (53/123) versus 31.7% (72/223) when not given; ($p = 0.045$). Survival was also associated with dispatcher experience: when the dispatchers handled <4 calls during the study period, survival to hospital discharge was 22.1% (17/77) compared to 38.2% (50/131) and 39.4% (65/165) when the call volume was 4–9 or >9 VF arrests ($p = 0.023$).[17]

3.4. The rate of bystander CPR

The rate of bystander CPR was increased when dispatch CPR programs were introduced at dispatch centres. In Ottawa the bystander CPR rate was 16.7% before implementation and 26.4% afterwards ($p = 0.006$).[11] The corresponding rates in King County were 30–32% before and 54–55% ($p = 0.001$) after implementation.[10,21]

3.5. Interval to the recognition of cardiac arrest and start of dispatcher-assisted CPR

The time intervals are presented in different ways in the included papers. The interval from the beginning of the call to the recognition of cardiac arrest in three studies was 170.2 ± 130.1 s (mean ± SD),[17] 75 s (39–104)[10] and 158 s.[11] The interval from the beginning of the call to the start of CPR instructions was 107 s (68–168)[10] and 283 s.[11] Reported circumstances that delayed instructions included dispatchers asking unnecessary questions

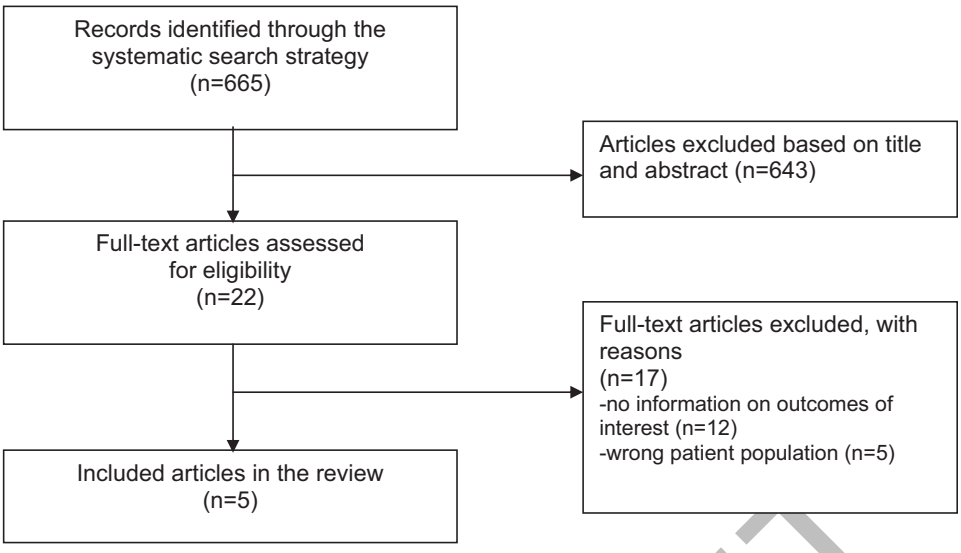

Fig. 1. Study selection process for studies included in the review.

such as "How old is the patient?" and questions regarding the patient medications.[10]

3.6. Rate of dispatch CPR instructions

Culley et al. reported that in 51% (132/267) of cases of dispatch CPR ventilation instructions were delivered while for compressions the rate was 32% (86/267).[10] Others showed that instructions of both compressions and ventilations were delivered in 25.7–75.9% of cases.[11,17,20,21] The most frequent reason for not delivering dispatcher-assisted CPR were that instructions were refused (12%), that EMS arrived rapidly (11%), that a trained bystander was present (11%) or that the dispatcher did not offer instructions (9%).[10] Vaillancourt and colleagues reported that 43.8% of cases of actual cardiac arrest were identified by dispatchers and among those CPR instructions were not initiated in 24.1% (26/108). The most frequent cause for not providing instructions was that CPR was already in progress or that it was difficult for the dispatcher to determinate the situation.[11]

4. Discussion

The results of this review showed one study with improved survival when dispatch CPR instructions were given,[17] three studies showed trends toward increased survival with dispatch CPR instructions[10,20,21] and one showed trend toward decreased survival.[11] All were retrospective or before-after studies. However, there are several interesting aspects revealed in the included studies.

The implementation of a dispatch CPR instruction program appears to have several positive effects on the very early treatment of out-of-hospital CA. We described four studies in which the implementation of a dispatch CPR instructions program showed significantly increased incidence of bystander CPR.[10,11,20,21] In one study the described increase was larger than after previous bystander CPR teaching interventions.[11] Even trained bystanders sometimes hesitate to start CPR and the dispatcher can also in these cases play an important role.[22]

Effective dispatcher-assisted CPR requires that a critical series of steps are rapidly accomplished, including the recognition of cardiac arrest and the provision of clear instructions that aid rescuers in performing quality CPR.[23] Failure to recognise cardiac arrest at the communication centre may result in delayed ambulance dispatch and omit the possibility of delivering CPR instructions. Included studies described reasons for inability to recognise CA such as agonal breathing and that the dispatcher had insufficient information[11] or made deviations from the protocol.[10] Dispatcher experience plays also an important role; low CA call numbers per dispatcher were associated with a decreased probability of survival. A significant difference were seen if the dispatcher handled less than four CA calls during the study period compared to four to nine or more than nine CA calls ($p = 0.02$).[17]

It is described that dispatcher-assisted CPR affects time intervals in different ways. In one included study it is reported that it required 2.4 min (mean) to deliver complete CPR instructions by telephone.[20] Hauff et al. did in another study a very thorough description of the call ($n = 138$) and reported a median time of completed instructions to 3.22 min.[29] Others found that mean time from collapse to CPR was approximately 1 min longer when dispatch CPR instructions were given than when CPR was performed by bystanders who did not require dispatcher assistance. It is suggested that the improvement of survival for both these groups (compared to no bystander CPR) was caused by reducing the interval from collapse to CPR. In the same study, among those who suffered a witnessed arrest, the survival advantage in the dispatcher-assisted CPR group increased with longer EMS response times.[21] This is in line with other studies who showed survival benefit associated with dispatcher-assisted CPR when compared to no bystander CPR before the EMS arrived mostly due to the shortened interval from collapse to initiation of CPR.[24]

Described reasons for delay in delivering the CPR protocol was that the dispatcher asked unnecessary questions or deviated from the protocol and above all, omitting the word "normally" when asking about breathing.[10] Another aspect is revealed in the study from Helsinki; time to return of spontaneous circulation (ROSC) was significantly shorter if the dispatcher recognised the CA within 150 s from the beginning of the call, compared to if it took a longer time.[17]

The PICO question given by the ILCOR guidelines organisation to the two work sheet authors did not address the actual performance of bystander CPR. Of the five studies analysed in this systematic review two studies[20,21] had in comparison to the three additional studies[10,11,17] a third patient group that did not received any CPR. This group however, is not specified in detail so we do not know if CPR instructions were given to any of these callers. In spite of the differences of the included patient groups in the

five studies it is clear that there is a beneficial effect of giving CPR instructions.

The results of these studies give only a very crude picture of the reality. For instance o natural causes no assessments of the quality of bystander CPR when guided by emergency medical dispatchers are available. It is suggested that the increased survival in the group of bystander CPR without assistance from dispatchers compared to the group of bystander CPR with assistance could be a question of differences of quality of CPR.[21] Simulation studies have shown contradicting results regarding the quality of dispatcher-assisted bystander CPR[9,25,26] and there may be opportunities to develop the instructions to achieve better results. An important aspect related to the implementation of dispatch CPR instruction programs is whether they can result in harm to patients. A prospective study showed that the frequency of serious injury related to dispatch CPR instruction among non-arrest patients was very low.[27]

The strength of this systematic review is that it followed a rigorous process developed by the ILCOR.[18] A strict policy on the monitoring and disclosure of conflicts of interests are included in this process as well as guidelines for evaluation and classification. There have been several opportunities for the work process to be peer-reviewed during international meetings and webinars. One of the limitations of the review is that the type of dispatcher-assisted CPR instructions provided in the included studies involved rescue breathing in addition to chest compressions. Current guidelines (2010) regarding dispatcher-assisted CPR for untrained rescuers recommend chest compressions alone. However, if a cardiac arrest is caused by asphyxia or if the patient is a child, chest compressions AND rescue breathing are still both recommended.[28] Only five studies were identified that addressed the impact of dispatch CPR instructions on survival, despite extensive and thorough review of the world's literature. In addition, the quality of the included studies was mostly "fair" and the level of evidence came from retrospective cohorts and before-after studies. There were no randomised-controlled studies published on this topic.

5. Conclusion

There is limited evidence supporting the survival benefit of dispatch-assisted CPR instructions. All studies comparing survival outcomes when CPR is provided with or without the assistance of dispatch-assisted CPR instructions lack the statistical power to draw significant conclusions. Studies comparing survival outcomes between groups where CPR is provided as a result of dispatch-assisted CPR instructions and those where CPR is not provided all show a survival benefit from dispatch-assisted CPR instructions. Until we have further evidence of the overall survival benefit of dispatch-assisted CPR instructions, and since it has been demonstrated that such instructions can improve bystander CPR rates, it is reasonable to recommend they should be provided to all callers reporting a victim in cardiac arrest.

Conflict of interest

Katarina Bohm received unrestricted fundings from SOS Alarm Sverige AB. Dr. Christian Vaillancourt received funding from the Canadian Institutes of Health Research and the Heart and Stroke Foundation to study dispatch-assisted CPR instructions. Manya Charette has no conflicts of interest to declare. Dr. James Dunford has no conflicts of interest to declare. Dr. Maaret Castrén received unrestricted fundings from SOS Alarm Sverige AB.

Disclaimer

This review includes information on resuscitation questions developed through the C2010 Consensus on Science and Treatment Recommendations process, managed by the International Liaison Committee on Resuscitation (http://www.americanheart.org/ILCOR). The questions were developed by ILCOR Task Forces, using strict conflict of interest guidelines. In general, each question was assigned to two experts to complete a detailed structured review of the literature, and complete a detailed worksheet. Worksheets are discussed at ILCOR meetings to reach consensus and will be published in 2010 as the Consensus on Science and Treatment Recommendations (CoSTR). The conclusions published in the final CoSTR consensus document may differ from the conclusions of in this review because the CoSTR consensus will reflect input from other worksheet authors and discussants at the conference, and will take into consideration implementation and feasibility issues as well as new relevant research.

Acknowledgement

SOS Alarm Sverige AB.

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