



Evidence-Based Medicine Journal Club

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Journal club critique

Rethinking bystander CPR for out-of-hospital cardiac arrest

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Expanded Abstract

Citation

SOS-KANTO study group: Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. *Lancet* 2007, 369:920-926 [1].

Background

Mouth-to-mouth ventilation is a barrier to bystanders doing cardiopulmonary resuscitation (CPR), but few clinical studies have investigated the efficacy of bystander resuscitation by chest compressions without mouth-to-mouth ventilation (cardiac-only resuscitation).

Methods

Objective: To compare the effect of bystander-provided cardiac-only resuscitation to conventional CPR in adults who had out-of-hospital cardiac arrest.

Design: Prospective multicenter observational study.

Setting: 58 emergency hospitals and emergency medical service units in the Kanto region of Japan.

Subjects: Patients with witnessed out-of-hospital cardiac arrest who were subsequently transported by paramedics to participating emergency hospitals. Exclusion criteria were age <18 years, further cardiac arrest after the arrival of paramedics, documented terminal illness, presence of a do-not-resuscitate order, and bystander resuscitation without documented chest compressions.

Intervention: None. On arrival at the scene, paramedics assessed the technique of bystander resuscitation, recording it as conventional CPR (chest compressions with mouth-to-mouth ventilation), cardiac-only resuscitation (chest compressions alone), or no bystander CPR. Patients

were followed and reevaluated 30 days after the arrest to determine neurologic status.

Outcome: The primary endpoint was favorable neurological outcome 30 days after cardiac arrest using the Glasgow-Pittsburgh cerebral-performance scale, with favorable neurological outcome defined as a category 1 (good performance) or 2 (moderate disability) on a 5-point scale.

Results

4068 adult patients who had out-of-hospital cardiac arrest witnessed by bystanders were included; 439 (11%) received cardiac-only resuscitation from bystanders, 712 (18%) conventional CPR, and 2917 (72%) received no bystander CPR. Any resuscitation attempt was associated with a higher proportion having favorable neurological outcomes than no resuscitation (5.0% vs 2.2%, $p < 0.0001$). Cardiac-only resuscitation resulted in a higher proportion of patients with favorable neurological outcomes than conventional CPR in patients with apnea (6.2% vs 3.1%; $p = 0.0195$), with shockable rhythm (19.4% vs 11.2%, $p = 0.041$), and with resuscitation that started within 4 min of arrest (10.1% vs 5.1%, $p = 0.0221$). However, there was no evidence for any benefit from the addition of mouth-to-mouth ventilation in any subgroup. The adjusted odds ratio for a favorable neurological outcome after cardiac-only resuscitation was 2.2 (95% CI 1.2-4.2) in patients who received any resuscitation from bystanders.

Conclusions

Cardiac-only resuscitation by bystanders is the preferable approach to resuscitation for adult patients with witnessed out-of-hospital cardiac arrest, especially those with apnea, shockable rhythm, or short periods of untreated arrest.

Commentary

Sudden cardiac arrest is a leading cause of death in the industrialized world [2]. Bystander cardiopulmonary resuscitation (CPR) can substantially improve outcomes, yet is typically provided in less than one in four cases of out-of-hospital cardiac arrest [3]. Aversions to mouth-to-mouth breathing or the complex nature of this task are thought to underlie the low rate of bystander CPR. An alternative to conventional CPR that avoids the need for mouth-to-mouth contact is cardiac-only resuscitation, in which continuous chest compressions are provided without rescue breathing. Animal models suggest that cardiac-only resuscitation is at least as effective as conventional CPR for sudden cardiac arrest, as reviewed by Ewy [4]. In some models, survival is actually better with cardiac-only resuscitation, perhaps because it minimizes interruptions in chest compressions for rescue breathing, which cause significant declines in perfusion pressure and blood flow. Prior studies in humans suggest that bystander-provided cardiac-only resuscitation is as effective as conventional CPR for out-of-hospital cardiac arrest [5-7]. Yet, these studies were criticized in that they either used observational designs, failed to assess the neurologic function of survivors, or took place in systems with rapid emergency medical services (EMS) response times, where bystander resuscitation may be less important.

In the current study (SOS-KANTO) [1], the authors compared 30-day neurologic outcomes of bystander-provided cardiac-only resuscitation to bystander-provided conventional CPR in 4068 adults victims of out-of-hospital cardiac arrest. Not surprisingly, any resuscitation attempt was associated with a more favorable neurological outcome than no resuscitation at all in this observational study. Yet, there was no difference in the proportion with favorable neurologic outcome between the cardiac-only resuscitation group and conventional CPR group (6% vs. 4% respectively, $P = 0.15$). Within certain *a priori* defined subgroups, adjusted neurologic outcomes were better with cardiac-only resuscitation, including patients with apnea at time of resuscitation, shockable initial rhythm (ventricular fibrillation or pulseless ventricular tachycardia), and those with short periods of untreated arrest. There was no evidence for any benefit from the addition of mouth-to-mouth ventilation in any subgroup of patients who received bystander resuscitation. Additionally, there were no subgroups that had a less favorable neurologic outcome with cardiac-only resuscitation as compared to conventional CPR.

SOS-KANTO is the first multicenter observation study in a densely populated urban area where bystanders were observed performing non-instructed resuscitation. This study has several strengths, including a large number of patients receiving cardiac-only resuscitation, adherence to Utstein-style reporting (the standard for studies of out-of-hospital cardiac arrest), 100% follow-up, and performance of multiple regression analyses to control for confounders. It has several limitations, however, that deserve consideration. This study was observational in nature and,

therefore, cannot prove causation. This study included subjects that were thought to have a non-cardiac cause of arrest, such as drug overdose, aspiration, or drowning. In such cases, arterial blood may be so severely deoxygenated that it contributes to hypotension and secondary cardiac arrest, making ventilation a more essential part of the initial resuscitation effort. This may be especially important in children, in whom respiratory etiologies predominate. Favorable neurologic outcome at 30 days did not differ by type of CPR received in the subgroup with non-cardiac etiologies. However, only four (1.2%) non-cardiac subjects reached this endpoint, thereby limiting the ability of the authors to detect a difference in this outcome. Quality of bystander resuscitation was not assessed, though a greater proportion of cardiac-only resuscitation being provided by bystanders with no prior training would have presumably biased against the cardiac-only group. Resuscitation event times were only known for 70% of the study population and post-resuscitation care, such as therapeutic hypothermia, was not standardized. By design, the type of resuscitation provided was not randomized. Though multivariable adjustment was used to control for potential confounders, it would have been reassuring for the authors to have included a propensity score for type of resuscitation in their analyses. The Kanto region of Japan is a very densely populated urban region where EMS response times are rapid. In SOS-KANTO, untreated arrest intervals were less than 6 minutes and total bystander resuscitation times were less than 12 minutes. Animal studies and extrapolation of clinical data suggest that ventilation does not appear to be a factor during the initial minutes of resuscitation when untreated arrest intervals are short [8-11]. Therefore, the results of SOS-KANTO are not necessarily generalizable to rural areas or other urban areas where EMS times are less rapid, to ongoing resuscitation by professional rescuers, to in-hospital resuscitation, or in the resuscitation of subjects that have been down for an unknown period of time.

Recently, two additional observational studies were published that compared cardiac-only and conventional bystander CPR [3,12]. Iwami and colleagues conducted a prospective, population-based, observational study involving adult subjects who suffered out-of-hospital cardiac arrest in the Osaka region of Japan, which includes both urban and rural communities [3]. Among the 4902 witnessed cardiac arrests, 783 received conventional CPR, and 544 received cardiac-only resuscitation. Like SOS-KANTO, neurologic outcomes were better with any, as opposed to no, resuscitation, with similar outcomes in cardiac-only and conventional CPR groups, at least for those with arrest intervals ≤ 15 minutes. For very-long-duration (>15 minutes) arrests, neurologically favorable 1-year survival was greater in the conventional CPR group, though there were few survivors in this subgroup regardless of the type of bystander CPR. Bohm and colleagues compared 1-month survival rates in patients with out-of-hospital cardiac arrest who received bystander resuscitation and who were reported to the Swedish Cardiac Arrest Register between 1990 and 2005 [12]. This registry includes larger cities, as

well as sparsely populated areas. Among subjects in the study, 8209 received conventional CPR, and 1145 received cardiac-only resuscitation. There was no difference in 1-month survival between groups, regardless of whether the ambulance response time was less than or greater than 8 minutes.

Determining whether bystander-provided cardiac-only resuscitation is truly as effective as conventional CPR in out-of-hospital cardiac arrest will require adequately powered randomized clinical trials focused on meaningful patient-centered outcomes. Two large prospective, randomized trials comparing cardiac-only and conventional CPR for subjects with out-of-hospital cardiac arrest are currently underway; one in the United States [13] and the other in Scandinavia. A third such study in England recently completed enrollment [14].

In the absence of definitive evidence from clinical trials, much controversy exists over bystander CPR [15-18]. To date, CPR is still primarily taught in the conventional form of chest compression with intermittent mouth-to-mouth ventilation. American Heart Association guidelines recommend cardiac-only resuscitation by bystanders in dispatcher-assisted resuscitation or when a rescuer is unwilling or unable to perform mouth-to-mouth ventilation [2]. Yet this technique is not generally known, recommended, or taught [1]. Fear of contracting a communicable disease through mouth-to-mouth ventilation and other concerns have long been roadblocks to bystander CPR. It has been proposed that teaching cardiac-only resuscitation may eliminate some of these barriers and could thus increase the total rate of bystander resuscitation. However, such an approach might be detrimental to some patient groups, such as those with long untreated arrest intervals or primary respiratory events. Paradoxically, asking bystanders to differentiate cardiac arrest from respiratory arrest and short response time from long response time prior to choosing resuscitation type would possibly confuse, intimidate, and further dissuade bystanders from attempting any type of resuscitation.

Recommendation

For out-of-hospital cardiac arrest, it is clear that any bystander resuscitation is better than no resuscitation at all and that unnecessary chest compression interruptions should be minimized. In those cases where a cardiac etiology is likely, cardiac-only resuscitation may be a reasonable option, especially if it significantly increases the proportion of bystanders willing to provide resuscitation.

Competing interests

The authors declare no competing interests.

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