Effect of active compression-decompression resuscitation (ACD-CPR) on survival: a combined analysis using individual patient data


Authors' objectives
To compare active compression decompression resuscitation (ACD-CPR) with standard cardiopulmonary resuscitation (S-CPR), by combining individual patient data (IPD) from completed prospective trials. In addition, to determine the effect on survival and neurological outcomes in patients with out-of-hospital cardiac arrest.

Searching
MEDLINE was searched from 1990 to 1995. In addition, the references of relevant papers were checked and investigators were contacted for any unpublished studies. An international collaborative study group was established.

Study selection
Study designs of evaluations included in the review
The review included IPD from prospective randomised controlled trials (RCTs).

Specific interventions included in the review
The inclusion criteria stated ACD-CPR compared with S-CPR. Studies also had to include retraining for S-CPR and training in advance in ACD-CPR.

Participants included in the review
Participants aged over 16 years with out-of-hospital cardiac arrest where CPR was attempted. Trauma patients and those with certain signs of prolonged time since arrest, such as rigor mortis, were excluded. The mean age of the participants was 65 years in the ACD-CPR group and 66 years in the S-CPR group.

Outcomes assessed in the review
The primary outcomes were short-term survival (1 hour) and hospital discharge rates (long-term survival). The secondary end points were neurological outcomes (cerebral and overall performance categories) at time of discharge and documented complications (rib and sternum fractures, aspiration, internal organ damage, pneumothorax, haemothorax, echymosis).

How were decisions on the relevance of primary studies made?
The trial investigators were contacted.

Assessment of study quality
The authors state that all the data supplied were subjected to the type of range and consistency checks that would be used for a prospective trial. Any missing data, obvious errors, inconsistencies between variables, or extreme values were queried and rectified as necessary. Where details of the trial had been published, these were checked against the raw data. All the changes were rechecked with appropriate investigators. One eligible trial was excluded as the investigators declined to take part in the collaboration.

Data extraction
Data were collected in a standard format, in a common database, by two statisticians unconnected with the original studies. The data extracted related to the circumstances at arrest (e.g. witnessed, bystander CPR) and the outcomes. The odds ratios (Ors) were calculated for one-hour survival, and discharge survival for individual studies.
Methods of synthesis
How were the studies combined?
The results were analysed on an intention-to-treat basis. The pooled ORs were calculated from a logistic regression model (and also a random-effects model). The statistical significance of treatment effects was assessed using a chi-squared test or Fisher’s test. Complication outcomes were pooled using contingency (2x2) tables and a statistical test for association (chi-squared test) between the outcomes and treatment.

How were differences between studies investigated?
The regression model was used to investigate the association between outcomes (survival and neurological recovery) and particular variables. A chi-squared test was used to test for trends. Using logistic regression methods, a subgroup analysis was used to examine treatment effects in pre-specified groups of patients (according to, for example, initial rhythm, bystander CPR, and time intervals to the arrival of emergency medical services and life support services).

Results of the review
Data from seven studies (2,866 participants) were included. Published data from the trial for which the investigators declined to provide IPD were also included in the analysis of discharge survival.

One-hour survival was 23.8% in the ACD-CPR group and 20.6% in the S-CPR group. The pooled OR showed a statistically-significant improvement in survival with ACD-CPR (OR 0.83, 95% confidence interval, CI: 0.695, 0.99, p<0.05). Discharge survival was 7% for the ACD-CPR group and 5.8% for the S-CPR group. The pooled OR showed no statistically-significant difference (OR 0.82, 95% CI: 0.609, 1.107, p=0.23). Overall survival was significantly increased by ACD-CPR (chi-squared test for trend, p=0.041). This improvement was largely due to the influence of one study site. The addition of published data from the study that declined to take part in the IPD review did not change the results for discharge survival. The subgroup analysis showed no statistically-significant differences except for those participants whose first ECG-rhythm was asystole; those participants benefited from ACD-CPR compared to S-CPR (OR 0.71, 95% CI: 0.54, 0.97).

Neurological outcomes and complication rates were comparable between the groups.

Authors’ conclusions
There was a statistically-significant improvement in survival with the use of ACD-CPR as compared to S-CPR. However, this improvement was largely due to one study. There was a significant improvement in one-hour survival with ACD-CPR as compared to S-CPR. The results were not significantly different between the two groups for the end point of hospital discharge.

CRD commentary
The aims of this IPD review are clearly stated. The database search was rather limited; however, the authors did contact investigators in the field. The study investigators of all relevant studies were contacted and a collaborative group was formed. The data collection and checking procedures were thorough. The method of analysis appears to have been appropriate (to IPD), but this aspect was not reported well. The authors acknowledged that the refusal of the investigators of one relevant study to take part in the review could have affected the results. They explored the possible impact of missing data and found it did not change the results for discharge survival. The significant improvement in survival shown for ACD-CPR over S-CPR only just reached statistical significance, and the positive effect was largely due to the results from one study. This analysis of IPD was unable to determine which patients are most likely to benefit.

Implications of the review for practice and research
Practice: It seems reasonable to consider the use of ACD-CPR in emergency medical settings when resources are available for adequate training and post-implementation surveillance.

Research: Further studies should be directed toward a better understanding of the factors underlying the potential
benefits of ACD-CPR in any given emergency medical service system, and to determine whether the results would be reproducible.

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