



Article Appraisal

Article: Trial of continuous or interrupted chest compressions during CPR

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Resident Reviewer Name(s) and Residency Affiliation: Dr. Baljeet Brar, Resident, RCPS-EM Program

Faculty Methodology/Bio-statistics Resource Person: Dr. Riyad Abu-Laban, DEM Research Director

Background and Study Objective(s):

Clinical equipoise exists regarding whether ventilations during continuous chest compression (CCC) or during interrupted chest compression (ICC) CPR leads to improved outcomes. Several animal studies, as well as bundled studies in humans where more than one CPR factor is changed, have suggested CCC increases survival. The objective of this study was to determine whether CCC improves survival to hospital discharge compared to ICC in adult patients with non-traumatic, non-EMS witnessed cardiac arrest.

Study Design:

This was a large, randomized trial that included 8 ROC (Resuscitations Outcomes Consortium) sites across North America and 114 EMS agencies (including ROC-BC and the BC Ambulance Service). The 114 agencies were divided into 47 clusters. The clusters were then randomly assigned each year to either CCC or ICC, with a crossover every 6 months to the other method throughout the course of the trial. Enrolment began in 2011 and ended in 2015. Clusters had to meet specified CPR process benchmarks during the run-in phase before they could actively enrol patients. Only patients enrolled in the active enrolment phase were analysed for the primary and secondary outcomes. CCC was defined as compressions at a rate of 100/min with asynchronous positive pressure ventilations at a rate of 10/min. ICC was defined as 30 chest compressions to 2 ventilations.

Results:

23,711 patients were enrolled; 12,653 in the intervention (CCC) group and 11,058 in the control (ICC) group. Survival to hospital discharge was 9.0% in the intervention and 9.7% in the control group ($p=0.07$). The secondary outcome of favorable neurologic outcome with a Rankin Score <3 was 7.0% in the intervention and 7.7% in the control group ($p=0.09$). The rate of transport to hospital was higher in the control group (54.8% vs 52.8%, $p=0.01$) as was the rate of ROSC on ED arrival (25.3% vs 24.2%, $p=0.07$). Hospital free survival was 1.3 days in the intervention group and 1.5 days in the control group ($p=0.03$).

A per-protocol analysis was undertaken that used a computer algorithm to classify patients into either CCC or ICC. This excluded 6,108 patients in the intervention group and 7,371 patients in the control group, and resulted in survival to hospital discharge rate of 7.6% in the intervention group and 9.6% in the control group ($p < 0.001$).

Validity of Results:

The sense amongst Journal Club attendees was that this was a sufficiently powered and impressively performed study with an analysis based on intention-to-treat. In the paper the conclusions were negatively stated, specifically that CCC did not result in a statistically significant higher survival, however there was a general sentiment that it was striking and potentially noteworthy that both primary and secondary outcomes of interest favored the ICC group, with a 93% probability that the increase in survival to discharge found, although statistically insignificant at the $P < 0.05$ threshold, did not arise by chance. Various reasons for this were postulated and discussed, as was the potential merit of taking a Bayesian approach to interpreting the study and in doing so considering the low “pre-study probability” that ICC is superior based on prior studies and evidence on the importance of maximizing chest compression fraction (CCF) to at least to the 0.6 level if not higher.

It was noted that there may not have been a large enough difference in the CCF between the groups (0.77 vs 0.83) to detect a difference if one exists, and possible reasons for this were discussed including the increasing secular trend across North America during the time of the trial towards believing that CCC was better, and the potential “watering down” effect the crossover design may have had. It was also noted that the duration of intervention, specifically when data was recorded on the defibrillator, may have also not been long enough to detect a difference (4.0 to 5.5 minutes). Problems surrounding the fact that the per-protocol analysis excluded over half the patients in the groups and resulted in groups that were no longer balanced were also raised; for example the per-protocol ICC group had a higher number of shockable rhythms and pre-hospital intubations. At the end of the discussion, Journal Club attendees were challenged to consider how they would have interpreted the study had the numeric results been identical with the exception that the $p = 0.07$ difference found favoured CCC rather than ICC.

Generalizability of Results:

It was felt the results would be generalizable to other sites with a high baseline CCF (regardless of the type of CPR they currently performed). As BC participated in the study, the results are clearly highly relevant and applicable to us, however it is difficult to confidently conclude that they should prompt a change from, or relaxation to, the current BCAS endorsement of CCC. It was noted that the EMS providers involved in the study were mostly ALS, the arrival times were short, and the EMS providers were highly trained and monitored through participation in this study and other ROC studies.

As a result, generalizability to other systems without these factors may be lessened. It is also possible that even across study sites, some favoured CCC with the preponderance favouring ICC. As such, changing CPR policy to ICC according to the overall aggregated results in a site that actually had better survival with CCC, would not be prudent.

The Bottom Line:

The general sentiment was that the results of this study were surprising given the general belief and widespread endorsement of CCC. It is already clearly established that good chest compressions with high CCF provides better survival outcomes. This study found no statistically significant difference by intention-to-treat analysis between the CCC and ICC, but led to results suggesting the possibility that ICC may be superior in at least some situations. These results may have arisen because of similar CCFs in both groups, selection bias, differences in ventilation (which could not be recorded), or design and implementation issues that undermined the ability to detect a significant difference that actually exists.

There was agreement amongst Journal Club attendees that it seems clear that the results suggest that CCC is not inherently better, in and of itself, than ICC with a high CCF. How best to apply these results to an individual EMS agency may thus depend on a consideration of the entire chain of survival from a local perspective, where the weakest links are, and where best to intervene and how to increase survival from OHCA. It is hoped that further light may be shed on the many questions this study raises though future anticipated subgroup and by-site analyses of the study data.