CPR: Chest compression to ventilation ratio- EMS delivered

Citation

Olasveengen T, Mancini MB, Berg, RA, Brooks S, Castren M, Chung SP, Considine J, Escalante R, Gazmuri R, Hatanaka T, Koster R, Kudenchuk P, Lim SH, Lofgren B, Nation, K, Nishiyma C, Perkins GD, Ristagno G, Sakamoto T, Sayre, M, Sierra A, Smyth M, Stanton D, Travers A, Valliancourt C, Morley P, Nolan J. CPR : Chest Compression to Ventilation Ratio-EMS Delivered. Consensus on Science and Treatment Recommendation [Internet]. Brussels, Belgium: International Liaison Committee on Resuscitation (ILCOR), Basic Life Support Task Force, 2017 July 30. Available from: http://www.ilcor.org

CPR: Compression to Ventilation PICOST

The PICOST (Population, Intervention, Comparator, Outcome, Study Designs and Timeframe)
Population: Patients of all ages (i.e., neonates, children, adults) with cardiac arrest from any cause and across all settings (in-hospital and outof-hospital). Studies that included animals were not eligible. Intervention: All manual CPR methods including Compression-only CPR (CO-CPR), Continuous Compression CPR (CC-CPR), and CPR with different compression-to-ventilation ratios. CO-CPR included compression with no ventilations, while CC-CPR included compression with asynchronous ventilations or minimally-interrupted cardiac resuscitation (MICR) Studies that mentioned the use of a mechanical device during CPR were only considered if the same device was used across all relevant intervention arms and would therefore not confound the observed effect.
Comparators: Studies had to compare at least two different CPR methods from the eligible interventions; studies without a comparator were excluded.
Outcomes: The primary outcome was favorable neurological outcomes, measured by cerebral performance or a modified Rankin Score. Secondary outcomes were survival, ROSC, and quality of life.
Study designs: Randomised controlled trials (RCTs) and non-randomised studies (non-randomised controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Study designs without a comparator group (e.g., case series, cross-sectional studies), reviews, and pooled analyses were excluded.
Timeframe: Published studies in English searched on January 15, 2016

For the critical outcome of favorable neurological function, we identified very low quality evidence from two cohort studies (Bobrow 2008 1158, Kellum 2008 244) and high quality evidence from one randomized controlled trial (Nichol 2015 2203). In an unadjusted analysis of crude data from one cohort study (Kellum 2008 244) patients who received continuous chest compressions had improved favorable neurological function (RR 2.58 (1.5, 4.47) RD 24.11 (11.58, 36.63)) when compared to those who received compressions and ventilations at a time when the compression to ventilation ratio was 15:2. The quality of evidence was downgraded for serious risk of bias and indirectness. In unadjusted analysis of crude data in the other cohort study (Bobrow 2008 1158) patients who received minimally interrupted cardiac resuscitation (initial series of 200 uninterrupted chest compressions before and after rhythm analysis with

shock if appropriate) had no demonstrable benefit for favorable neurological function (RR 0.81 (0.57-1.13); RD -11.30 (-28.48, 5.87)) when compared to conventional CPR (mixture of 30:2 CPR and 15:2). The quality of evidence was downgraded for serious indirectness and imprecision. In unadjusted analysis of crude data from a randomized controlled trial (Nichol 2015 2203) patients who were randomized to positive-pressure ventilations delivered without pausing chest compressions had no demonstrable benefit for favorable neurological function (RR 0.92 (0.84, 1.00); RD -0.65 (-1.31, 0.02)) when compared to patients randomized to conventional CPR (30:2).

For the critical outcome of survival, we identified very low quality evidence from one cohort study (Bobrow 2008 1158) and high quality evidence from one randomized controlled trial (Nichol 2015 2203). In unadjusted analysis of crude data from the cohort study (Bobrow 2008 1158) patients who received minimally interrupted cardiac resuscitation had improved survival (RR 2.37 (95% CI 1.69-3.31); RD 5.24 (2.88, 7.60) when compared to conventional CPR (mixture of 30:2 and 15:2). The quality of evidence was downgraded for serious indirectness. In unadjusted analysis of crude data from a randomized controlled trial (Nichol 2015 2203) patients who were randomized to positive-pressure ventilations delivered without pausing chest compressions had a relative risk of survival of 0.92 (95% CI 0.85-1.00) compared to patients randomized to conventional CPR (30:2).

For the critical outcomes of return of spontaneous circulation, we identified very low quality evidence from one cohort study (Bobrow 2008 1158) and high quality evidence from one randomized controlled trial (Nichol 2015 2203). In unadjusted analysis of crude data from the cohort study (Bobrow 2008 1158) patients who received minimally interrupted cardiac resuscitation had improved return of spontaneous circulation (RR 1.61 (1.38, 1.89); RD 10.64 (6.80, 14.49)) when compared to conventional CPR (30:2 or 15:2). The quality of evidence was downgraded for serious indirectness. In unadjusted analysis of crude data from a randomized controlled trial (Nichol 2015 2203) patients who were randomized to positive-pressure ventilations delivered without pausing chest compressions had slightly lower return of spontaneous circulation (RR 0.96 (95% CI 0.91-1.00); RD -1.15 (-2.25, -0.05)) when compared to patients randomized to conventional CPR (30:2).

Treatment recommendations

We recommend EMS providers perform CPR with 30 compressions to 2 ventilations or continuous chest compressions with positive-pressure ventilations delivered without pausing chest compressions until a tracheal tube or supraglottic device has been placed (strong recommendation, high quality evidence).

We suggest that where EMS systems have adopted bundles of care involving the initial provision of minimally interrupted cardiac resuscitation, the bundle of care is a reasonable alternative to conventional CPR for witnessed shockable out of hospital cardiac arrest (weak recommendation, very-low-quality evidence).

Values and Preferences

These recommendations reflect the high quality of evidence supporting the safety of continued use of conventional 30:2 CPR among EMS providers, yet lack of data supporting superior functional or survival outcomes. They also place a relatively high value on the importance of provision of high-quality chest compressions and simplifying resuscitation logistics for EMS systems with demonstrated clinical benefit of bundles of care involving minimally interrupted cardiac resuscitation, and a relatively low value on the uncertainties surrounding effectiveness, acceptability, feasibility, and resource use.

Knowledge gaps

Current knowledge gaps include but are not limited to:

- The effect of delayed ventilation versus 30:2 high-quality CPR.
- The duration of maximum delay in positive-pressure ventilation.
- The ability of EMS providers to perform correct bag-mask ventilations during CPR.
- The effect of hyperventilation on circulation during chest compressions.
- The effect of hyperventilation on outcomes for cardiac arrest patients.
- Effects of ventilation attempts during an obstructed airway, effects of gastric inflation.
- Which elements of the bundled care (compressions, ventilations, delayed defibrillation) are most important?
- What is the optimal method for ensuring a patent airway?
- Is there a critical volume of air movement required to maintain effectiveness?
- How effective is passive insufflation?