Critical Review Form
Meta-analysis

PGY-4

Larik MO, Ahmed A, Shiraz MI, Shiraz SA, Anjum MU, Bhattarai P. Comparison of manual chest compression versus mechanical chest compression for out-of-hospital cardiac arrest: A systematic review and meta-analysis. Medicine (Baltimore). 2024 Feb 23;103(8):e37294.

Objectives: **"to compare the usage of both manual chest compression and mechanical chest compression for various clinical cardiovascular outcomes, along with prespecified subgroup analyses performed based on the type of device (LUCAS, AutoPulse, and others) and the study design (randomized, prospective observational, and retrospective observational)." (p. 2)**

Methods: **A literature search from inception to May 2023 was performed using PubMed/MEDLINE, the Cochrane Library, and Scopus. The bibliographies of relevant articles were searched for additional studies. Studies reporting comparisons of manual versus mechanical chest compressions in out-of-hospital cardiac arrest (OHCA), reporting at least one of the outcomes of interest, and published as either randomized controlled trials, and non-randomized studies (prospective or retrospective) were eligible for inclusion. Outcomes of interest were return of spontaneous circulation (ROSC), survival to hospital discharge, survival to hospital discharge with a a favorable neurologic outcome (Cerebral Performance Category [CPC] score 1 or 2), survival for up to 24 hours, and survival for up to 30 days.**

Out of an initial 600 studies identified in the literature search, 24 were met inclusion criteria and were included in the systematic review and meta-analysis. These studies comprised 111,681 patients, of whom 83,599 were in a manual chest compression group and 28,082 were in a mechanical chest compression group.

Critical Review Form: Meta-Analysis

Guide	Comments
Are the results valid?	
Did the review explicitly address a sensible question?	Yes. Given the increasing use of mechanical compression devices by paramedic agencies for OHCA and the theoretical benefits of more consistent chest compressions with these devices it is sensible to perform a systematic review to better understand the effect of these devices on patient-centered outcomes.
Was the search for relevant studies detailed and exhaustive?	No. The authors searched PubMed/MEDLINE, the Cochrane Library, Scopus, and the bibliographies of relevant articles. They did not search registries of clinical trials (such as clinicaltrials.gov) or conference abstracts for unpublished trials (publication bias).
Were the primary studies of high methodological quality?	No. Of the 24 included studies, only 8 were randomized controlled trials (4 cluster randomized, 4 individual randomized) and 1 prospective non-randomized trial. Of the remaining 15 studies, 13 were cohort studies and 2 were case-control studies. The RCTs were of moderate

	quality, with concerns about the randomization process, the timing of identification or recruitment of participants in cluster-randomized trials, and deviations from the intended treatment. Additionally, blinding was not feasible in any of these studies. The prospective non-randomzied trial was of moderate quality and the cohort/case-control studies were of high quality.
Were the assessments of the included studies reproducible?	Yes. Risk of bias and quality assessment were performed using the Newcastle-Ottawa Scale (NOS) for Quality Assessment of Cohort Studies and the Cochrane Risk of Bias Tool for Randomized Controlled Trials.
What are the results?	
What are the overall results of the study?	• There were no significant differences observed in ROSC (OR: 0.90; 95% CI 0.79 to 1.03; $P = .13$; $I^2 = 88\%$). o Subgroup analysis based on mechanical compression device (LUCAS, AutoPulse, or other) also found no difference between groups with respect to ROSC. • There were no significant differences observed in the rate of survival to discharge (OR: 1.12; 95% CI 0.89 to 1.40; $P = .34$; $I^2 = 80\%$) and no differences on subgroup analysis based on device. • The cohort undergoing manual compression demonstrated significantly higher rates of a favorable neurological outcome when compared to mechanical compression (OR: 1.41; 95% CI 1.07 to 1.84; $P = .01$; $I^2 = 84\%$). • There were no significant differences observed in 24-hour survival (OR: 0.77; 95% CI 0.49 to 1.20; $P = .24$; $I^2 = 88\%$) and no significant differences observed in survival beyond 30 days (OR: 1.05; 95% CI 0.84 to 1.32; $P = .65$); $I^2 = 0\%$).
How precise are the results?	See above.
Were the results similar from study to study?	No. There was significant heterogeneity between study results (I^2 = 80-88%) for all outcomes except survival beyond 30 days, which was only reported in 3 trials.
Will the results help me in caring for my patients?	
How can I best interpret the results to apply them to the care of my patients?	The evidence presented here does not show any benefit to the use of mechanical chest compression devices in OHCA for any patient-centered outcome, and in fact demonstrated higher rates of a favorable neurological outcome when compared to mechanical compression (OR: 1.41; 95% CI 1.07 to 1.84).
Were all patient important outcomes considered?	Yes. The authors considered short-term and long-term survival as well as survival with a good neurologic outcomes.
Are the benefits worth the costs and potential risks?	No. This meta-analysis and several large, randomized trials have demonstrated no improvement in survival with the use mechanical chest compression devices in OHCA. Only 1 of 13 studies reporting survival with a good neurologic demonstrated improvement with mechanical compression, and this was a retrospective observational study; the meta-analysis of studies demonstrated a statistically significant decrease in favorable neurologic outcomes with mechanical compressions.

Limitations:

1. **The authors did not search registries of clinical trials (such as clinicaltrials.gov) or conference abstracts for unpublished trials, raising the risk of publication bias.**
2. **The studies were not of high overall quality, with only 8 of 24 being randomized controlled trials of only moderate quality.**
3. **The authors chose to pool the results of studies of highly disparate methodology (RCTs, retrospective observational studies, case-control studies).**
4. **There was significant heterogeneity between study results (I^2 = 80-88%) for all outcomes except survival beyond 30 days, which was only reported in 3 trials.**

Bottom Line:

This meta-analysis of 24 published studies demonstrated no improvement in survival at any timepoint with the use mechanical chest compression devices in OHCA compared with manual compressions, and demonstrated a statistically significant decrease in favorable neurologic outcomes with mechanical compressions (OR: 1.41; 95% CI 1.07 to 1.84; *P* = .01; I^2 = 84%).