



Spring 2023

Manual vs. Mechanical Chest Compressions in Adult Cardiac Arrest

Brittany Almquist
University of North Dakota

[How does access to this work benefit you? Let us know!](#)

Follow this and additional works at: <https://commons.und.edu/pas-grad-posters>

Recommended Citation

Almquist, Brittany, "Manual vs. Mechanical Chest Compressions in Adult Cardiac Arrest" (2023). *Physician Assistant Scholarly Project Posters*. 253.
<https://commons.und.edu/pas-grad-posters/253>

This Poster is brought to you for free and open access by the Department of Physician Assistant Studies at UND Scholarly Commons. It has been accepted for inclusion in Physician Assistant Scholarly Project Posters by an authorized administrator of UND Scholarly Commons. For more information, please contact und.common@library.und.edu.

Manual vs. Mechanical Chest Compressions in Adult Cardiac Arrest

Brittany Almquist, PA-S and Julie Solberg, PA-C

Department of Physician Assistant Studies, University of North Dakota School of Medicine & Health Sciences

Grand Forks, ND 58202-9037



Abstract

The purpose of this project is to compare the use of manual versus mechanical chest compressions during cardiopulmonary resuscitation (CPR) in the treatment of adult cardiac arrest patients. A literature review was performed using the databases CINAHL, Embase, and PubMed. Studies chosen were peer reviewed randomized controlled trials, respective reviews, a cross-over controlled trial, and an experimental trial. Only articles from the last seven years were included in this review. After exclusion criteria were applied, ten articles were relevant and utilized. Four themes were identified in the literature review, including the achievement of ROSC (return of spontaneous circulation), 30-day survival rate, injuries related to chest compressions, and chest compression reproducibility. The evidence shows an increase in ROSC with the use of mechanical chest compressions versus the use of manual chest compressions but no statistically significant difference in 30-day mortality rate between the two methods. It was found that there is an increase in chest compression related injuries with the use of mechanical chest compressions, but the injuries were not life-threatening. Chest compressions with the use of the mechanical devices were shown to be performed at a rate and depth more consistent with the American Heart Association than those performed manually. Further research needs to be performed with larger patient populations to make official best practice standards for chest compressions in adult cardiac arrest patients.

Introduction

Cardiac arrest occurs when there is a cessation of cardiac function, and there are many causes of cardiac arrest. The goal of a resuscitation attempt is the return of spontaneous circulation (ROSC). The chance of survival is higher with early recognition and treatment of cardiac arrest. There are mechanical chest compression devices, such as the LUCAS and AutoPulse to aid in the performance of chest compressions.

Statement of the Problem

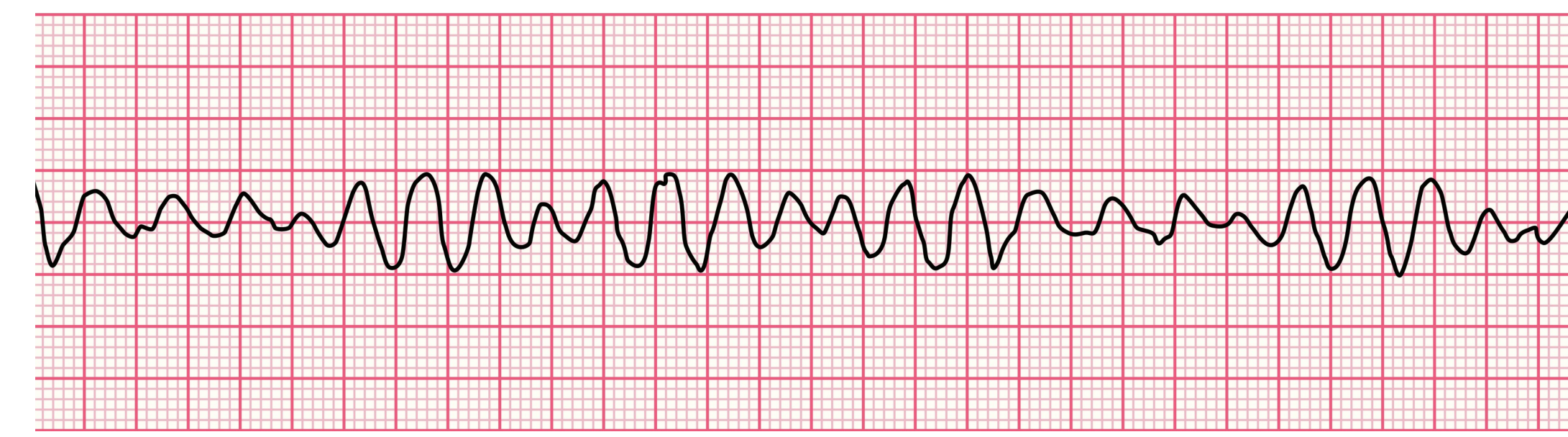
Approximately 350,000 individuals die annually as a result of out-of-hospital cardiac arrest (AHA, 2022). The overall survival rate globally following cardiac arrest is 10.7% at one month and 7.7% at one year (Yan et al., 2020). Early recognition of cardiac arrest along with prompt initiation of chest compressions and defibrillation can double or triple the likelihood of survival (AHA, 2022).



Shutterstock User ID: 378530467

Research Question

Is there a statistically significant difference in the outcomes and reproducibility of mechanical versus manual chest compressions in adult cardiac arrest patients without a traumatic cause of arrest?



Shutterstock User ID: 378530467

Literature Review

Achieving ROSC in Cardiac Arrest Patients

- Perkins et al. (2015) and Crowley et al. (2020) found an increase in achieving ROSC in cardiac arrest patients with the use of the LUCAS over the use of manual chest compressions.
- Anantharaman et al. (2017) found an increase in ROSC with the early application of a mechanical device over manual chest compressions. However, it was shown that manual chest compressions had a higher rate of ROSC than did late application of the device.
- A study performed by Halhalli et al. (2020) showed no statistically significant difference between the use of manual or mechanical chest compressions.

Thirty-Day Survival of Cardiac Arrest Patients

- Perkins et al. (2015) found that the 30-day survival was very comparable between manual and mechanical chest compressions.
- Anantharaman et al. (2017) found an increase in 30-day survival with early application of the LUCAS device over both manual compressions and late application of the device.
- Halhalli et al. (2020) found no significant change in 30-day survival between the two methods of chest compressions.
- Schmidbauer et al. (2017) was unable to form a definitive conclusion regarding the 30-day survival of cardiac arrest patients.

Secondary Injuries Related to Chest Compressions

- Karasek et al. (2020) concluded that there are no major differences in injuries following cardiac arrest between manual and mechanical chest compressions.
- Ondruschka et al. (2018) showed a significant increase in rib fractures with the use of the mechanical device; however, both methods of chest compressions had a significant number of injuries. Ondruschka et al. concluded that the main contributions related to injuries were the duration of CPR and the age of the patient. It was also concluded that the severity of injuries was similar between the two chest compression methods.
- Viniol et al. (2019) found more severe injuries with the use of a mechanical chest compression device.
- Koster et al. (2017) concluded no difference in severity of injuries between the two chest compression methods.

Chest Compression Reproducibility

- Bekgoz et al. (2021) showed more effectiveness, in terms of rate and depth, of chest compressions with the utilization of a mechanical device. There was no significant difference in hands-off time between the two methods.
- Gyrorry (2017) found no difference between the two chest compression methods in regards of time to patient contact, CPR initiation, defibrillation, or hospital arrival time. The average number of chest compressions per minute via mechanical chest compressions was more aligned with the AHA guidelines than was with the use of manual compressions. It was also noted that there was less hands-off time with the use of the mechanical device.

Discussion

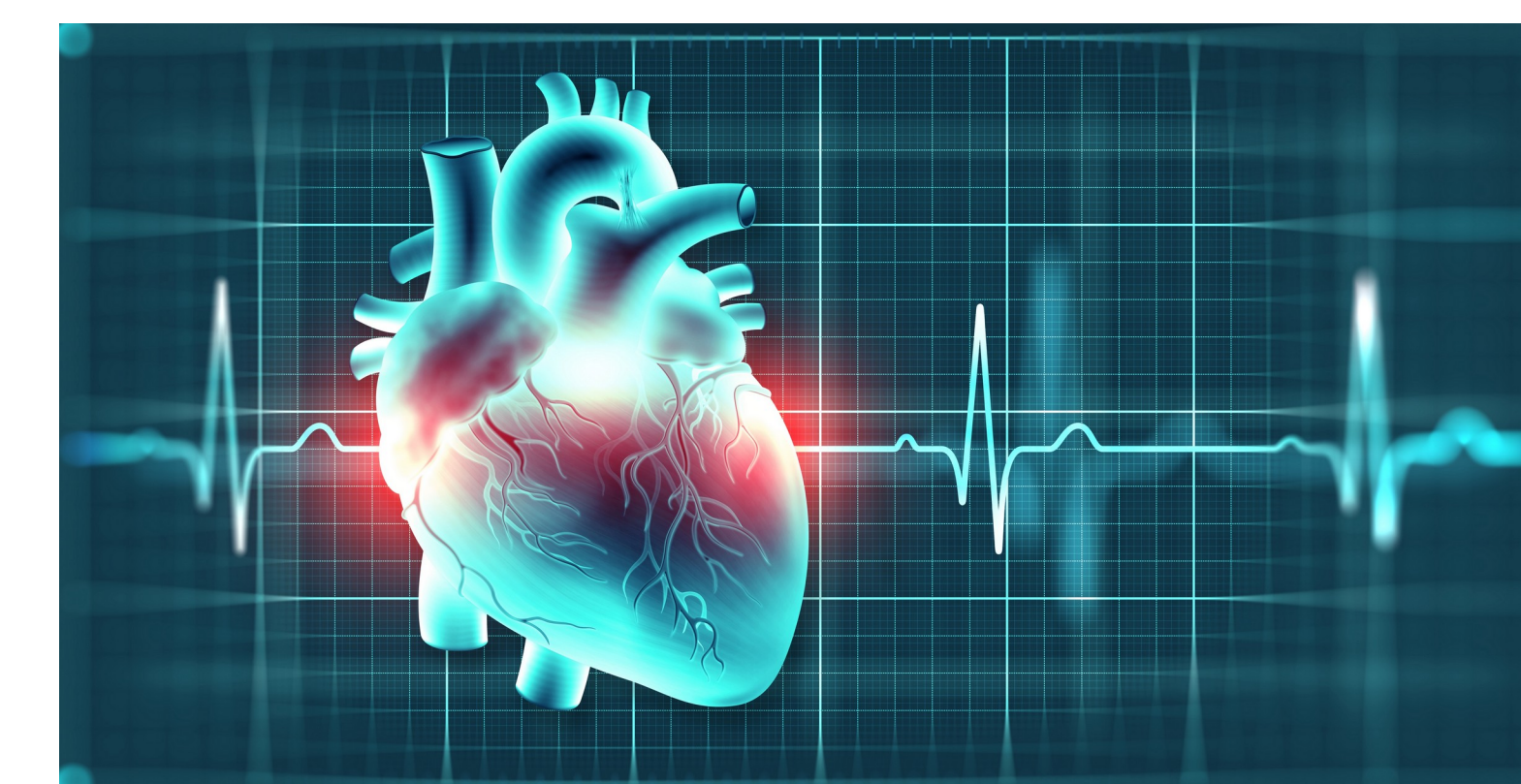
Mechanical chest compression devices are a great asset in a resuscitation attempt. Three out of four studies in this research showed an increase in ROSC with the utilization of a mechanical chest compression device. Chest compression injuries are common whether a mechanical device is used, or manual chest compressions are performed; however, there were more injuries noted with the mechanical device. Injuries in the literature utilized were not life threatening. The literature did not show a significant difference in 30-day survival between the two methods of chest compressions. The mechanical devices may be more beneficial in long resuscitation attempts, such as in a hypothermia, when CPR must be continued until the individual warms up. Ultimately, mechanical chest compression devices will likely perform higher quality chest compressions that are more consistent with AHA guidelines than a fatigued compressor would, but the main importance is continuous chest compressions no matter the method. Further research needs to be done with double blinded studies to further evaluate the two methods of chest compressions before best practice standards can be made.



Shutterstock User ID: 378530467

Applicability to Clinical Practice

Early recognition and initiation of CPR is crucial to survival. Survival from cardiac arrest has been shown to be higher with early initiation of CPR and defibrillation. Chest compressions at a rate of 100-120 per minute and with a depth of approximately 5 cm are necessary to maintain perfusion to the main organs of the body (AHA, 2022). Compressor fatigue is a common issue leading to poor quality chest compressions. Using a mechanical chest compression device in cases of long resuscitation attempts can help reduce compressor fatigue and ultimately lead to better compressions, perfusion, and outcome for the patient.



Shutterstock User ID: 378530467

References

- Anantharaman, V., Ng, B. L., Ang, S. H., Lee, C. Y., Leong, S. H., Ong, M. E., Chua, S. J., Rabind, A. C., Anjali, N. B., & Hao, Y. (2017). Prompt use of mechanical cardiopulmonary resuscitation in out-of-hospital cardiac arrest: the MECCA study report. *Singapore medical journal*, 58(7), 424-431. <https://doi-org.ezproxylr.med.und.edu/10.11622/smedj.2017071>
- Bekgöz, B., Şan, İ., Ergin, M., & Usul, E. (2021). Manual cardiopulmonary resuscitation versus mechanical cardiopulmonary resuscitation: Which one is more effective during ambulance transport? *Turkish Journal of Emergency Medicine*, 21(2), 69. <https://doi.org/10.4103/2452-2473.309135>
- Crowley, C. P., Wan, E. S., Salciocci, J. D., & Kim, E. (2020). The use of mechanical cardiopulmonary resuscitation may be associated with improved outcomes over manual cardiopulmonary resuscitation during In-hospital cardiac arrests. *Critical Care Explorations*, 2(11). <https://doi.org/10.1097/ccx.0000000000000261>
- Gyory, R. A., Buchle, S. E., Rodgers, D., & Lubin, J. S. (2017). The Efficacy of LUCAS in Prehospital Cardiac Arrest Scenarios: A Crossover Mannequin Study. *The western journal of emergency medicine*, 18(3), 437-445. <https://doi.org/10.5811/westjem.2017.1.32575>
- Halhalli, H. C., Şancı, E., & Uslu, T. (2020). The Comparison of Manual and Mechanical Chest Compression on Survival and Long-Term Neurological Outcome of Nontraumatic Out-of-Hospital Cardiac Arrest Patients. *The Journal of emergency medicine*, 59(5), 680-686. <https://doi.org/10.1016/j.jemermed.2020.06.010>
- High-Quality CPR. American Heart Association. (2022). Retrieved November 3, 2022, from <https://cpr.heart.org/en/resuscitation-science/high-quality-cpr>
- Koster, R. W., Beenen, L. F., van der Boom, E. B., Spijkerboer, A. M., Tepaske, R., van der Wal, A. C., Beesems, S. G., & Tijssen, J. G. (2017). Safety of mechanical chest compression devices AutoPulse and LUCAS in cardiac arrest: a randomized clinical trial for non-inferiority. *European heart journal*, 38(40), 3006-3013. <https://doi-org.ezproxylr.med.und.edu/10.1093/eurheartj/ehx318>
- Ondruschka, B., Baier, C., Bayer, R., Hammer, N., Dreßler, J., & Bernhard, M. (2018). Chest compression-associated injuries in cardiac arrest patients treated with manual chest compressions versus automated chest compression devices (Lucas II) – a forensic autopsy-based comparison. *Forensic Science, Medicine and Pathology*, 14(4), 515-525. <https://doi.org/10.1007/s12024-018-0024-5>
- Perkins, G. D., Lall, R., Quinn, T., Deakin, C. D., Cooke, M. W., Horton, J., Lamb, S. E., Slowther, A. M., Woollard, M., Carson, A., Smyth, M., Whitfield, R., Williams, A., Pocock, H., Black, J. J., Wright, J., Han, K., Gates, S., & PARAMEDIC trial collaborators (2015). Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial. *Lancet (London, England)*, 385(9972), 947-955. [https://doi.org/10.1016/S0140-6736\(14\)61886-9](https://doi.org/10.1016/S0140-6736(14)61886-9)
- Schmidbauer, S., Herlitz, J., Karlsson, T., Axelsson, C., & Friberg, H. (2017). Use of automated chest compression devices after out-of-hospital cardiac arrest in Sweden. *Resuscitation*, 120, 95-102. <https://doi.org/10.1016/j.resuscitation.2017.09.004>
- Viniol, S., Thomas, R. P., Gombert, S., König, A. M., Betz, S., & Mahnken, A. H. (2020). Comparison of different resuscitation methods about injury patterns in cardiac arrest survivors based on computer tomography. *European journal of radiology*, 131, 109244. <https://doi-org.ezproxylr.med.und.edu/10.1016/j.ejrad.2020.109244>
- Yan, S., Gan, Y., Jiang, N., Wang, R., Chen, Y., Luo, Z., Zong, Q., Chen, S., & Lv, C. (2020). The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis. *Critical care (London, England)*, 24(1), 61.

Acknowledgements

I would like to thank my scholarly project advisor, Julie Solberg, PA-C and instructor, Russ Kauffman, PA-C for their guidance through this scholarly project. I would also like to thank my husband, family, and friends for their patience and support throughout the duration of this project and the Physician Assistant program over the past two years.