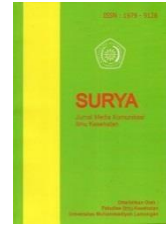




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Mechanical Cardiopulmonary Resuscitation (CPR) Is Better Than Manual CPR? Literature Study

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ABSTRACT

Introduction: Mechanical CPR reduces first aid fatigue and ensures compliance with guidelines, potentially increasing overall safety figures. In contrast, manual CPR relies on the skills of the rescuer, thus posing challenges in maintaining performance and endurance. Uncovering the complexity of this problem is important in shaping the resuscitation paradigm in the future. The purpose of this study is to determine the effectiveness of mechanical CPR in the management of cardiac arrest compared to manual CPR

Methods: The databases used were Pubmed and Proquest using the keywords "Mechanical CPR", "Automatic CPR Device" and "Cardiac Arrest". The inclusion criteria were published in the last 5 years, analyzing the effect of automated CPR devices on cardiac arrest management, as well as full-text articles in English. The exclusion criteria are literature review, systematic review or non-original research. The number of articles that are worthy of review is 10 journal articles

Results: The use of automatic CPR equipment is still inferior to manual CPR in cardiac arrest with a usability value of 4-5% of all heart attack patients. There are 4 journals that state that HJLRS in the management of cardiac arrest using automatic CPR equipment is higher than manual, but there are 2 journal articles that report the opposite. Automated CPR equipment is particularly vulnerable to injuries with fractures accounting for 85.5% of total injuries compared to manual CPR that does not have an injury.

Conclusion: The use of automatic CPR device does not produce better results than manual CPR overall for ROSC, but is very useful and meaningful in certain conditions such as during the transportation process, therefore, the automatic CPR device is more meaningful for pre-hospital use

Keywords: CPR, Manual CPR, Mechanical CPR, OHCA

INTRODUCTION

The safety rate of cardiac arrest patients is 8% and is the largest cause of millions of premature deaths in the world (Chen et al. 2017; Lu et al. 2016). Out-of-hospital cardiac arrest (HJLRS) is a major problem with a global incidence of around 14-147 per 100,000 people per year. (Liou et al. 2021; Murphy et al. 2022). More than 356,000 HJLRS occur in the United States each year (American Heart Association 2021). 80% of HJLRS victims die before receiving help from health workers (Lu et al. 2016).

The HJLRS mortality rate in South Korea is 97.7% while in China it is above 90%. (Chen et al. 2017; Jin et al. 2013). The high death rate of HJLRS is caused by the victim not immediately getting the right action at the time of the incident, one of which is due to the absence of witnesses, the absence of witnesses who can help, and remote health facilities. The chances of safety of HJLRS victims decrease by 7-10% every minute if no intervention is given (Chen et al. 2017).

The incidence of cardiac arrest has not been optimally recorded in Indonesia. However, the incidence of cardiac arrest can increase along with the increase in the incidence of Coronary Heart Disease (CHD). It is estimated that 10,000 people per year or about 30 people experience a heart attack every day in Indonesia (Yunus and Damanasyah 2017).

The survival of HJLRS patients is influenced by several factors, including cardiopulmonary resuscitation (CPR), AED access, and well-organized emergency medical services (EMS) (Yang et al. 2022). The quality of CPR is one of the main determining factors in the lives of cardiac arrest victims (Cha et al. 2019; Ng et al. 2021; Sudiro 2020). According to Poole, et al (2018) CPR is a key factor in

the survival of cardiac arrest patients (Poole et al. 2018).

The implementation of CPR does not have a time guarantee, there is no guarantee that with 5 cycles of CPR, cardiac arrest patients will return to Return of Spontaneous Circulation (ROSC) or Spontaneous Circulation. So the provision of quality RJP must be really consistent. The quality of the CPR is shown by a chest compression frequency of 100-120x/minute, a depth of 5-6 cm, minimal lag time and perfect recoil at each compression. (Panchal et al. 2020).

A quality CPR will be very difficult to do when the patient is in a moving ambulance or during transportation and evacuation such as on a stretcher. (Halperin and Carver 2010; Jörgens et al. 2021; Yang et al. 2022). Performing CPR on uneven and soft areas also affects the quality of CPR, as it is difficult to reach a depth of at least 5 cm. (Poole et al. 2018).

The automatic RJP tool can be an alternative tool to maintain good quality of RJP by avoiding helper fatigue, especially in poor resuscitation situations. (Cha et al. 2019; Poole et al. 2018). Halperin and Carver (2010) also said that automated CPR tools can provide high-quality chest compressions to moving ambulances, which is very difficult to do with manual CPR. (Halperin and Carver 2010).

Previous studies obtained different results, Spiro, et al (2015) stated that the results of mechanical CPR were better compared to manual CPR, with a survival rate of 11% for patients who used manual CPR while those who used the Automatic CPR tool was 28% (Spiro et al. 2015). The results of Zeiner, et al (2015) showed that the use of mechanical CPR tools had worse results based on brain performance category (CPC) measurements compared to the group that received manual CPR, which was 58.8%

compared to 78.6% in patients with mechanical CPR. RJP guidelines (Zeiner et al. 2015). Another result, Sudiro (2020) said that there was no difference in survival rates in automatic and manual CPR interventions. (Sudiro 2020).

Based on the explanation above, it is very necessary to conduct a literature study on the implementation of RJP using mechanical tools and manual RJP. Different results are possible due to bias in each study. In each study, the use of methods, sampling and implementation of research allow for different conclusions to be obtained. Each study may have its own shortcomings that should be evaluated

METHODS

The method used in this study is a literature study. The data used in this study is secondary data of journal articles through article search using Pubmed and Proquest databases. journal articles reviewed in the study using the keywords "Mechanical CPR", "Automatic CPR Device" and "Cardiac Arrest".

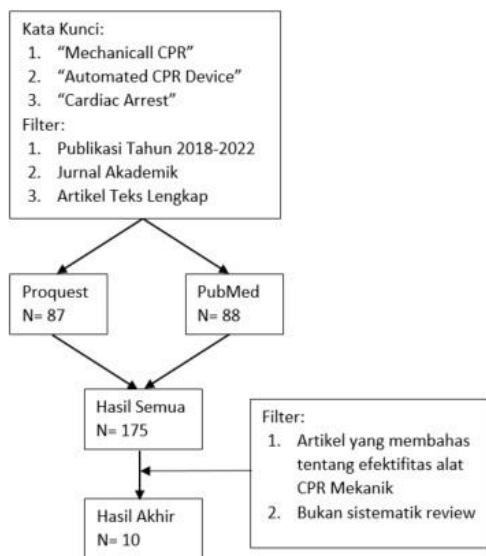


Figure 1. Article search chart.

The articles reviewed in this study must meet the inclusion criteria, namely articles published in 2018-2022 in United Kingdom, analysis of the effect of automated CPR tools on the management of cardiac arrest, and full-text articles. While the exclusion criteria are articles in the form of literature reviews or not original research.

RESULTS

The search results of the article can be seen in table 1 (Appendix). Based on the search results of the article, table 2 below is the characteristics of the article.

Tabel 2. Karakteristik Artikel

Metode		n	%
Kriteria Artikel	Artikel Teks Lengkap	10	100
Teknik Sampling	Studi Retrospektif	10	100
Instrumen	Alat RJP Otomatis Merk LUCAS	2	20
	Alat RJP Otomatis Merk LUCAS dan Autopulse	1	10
	Alat RJP Otomatis tanpa menyebutkan merk	7	70
Variabel	ROSC	7	70
	Neurologic	1	10
	Trauma	1	10
	Transport ke Rumah Sakit	1	10
Analisis Statistik	t-Test	2	20
	Logistic Regresion	1	10
	Chi Square	6	60
	Mann-Whitney	1	10

In Table 2, you can see the characteristics of 10 articles where the type of tool used is an automatic CPR tool, 7 articles do not mention the brand and 3 articles mention the LUCAS brand. Meanwhile, the most widely used statistical analysis is Chi-Square and Paired T-test (60%).

DISCUSSION

a. The using of Automatic CPR Equipment

The use of automated CPR tools can provide more consistent compression (speed and depth) than manual compression. However, the AHA does not recommend the use of automated CPR tools because there is no

evidence that automatic tools provide better results than manual compression.

Relieving fatigue, consistent and reliable chest compressions are the main advantages of automatic CPR tools. However, there is still some evidence of harm and lack of clinical benefits of mechanical CPR, namely pneumothorax, rib fractures, and visceral injuries. (Kim et al. 2019).

Although the use of an automated RJP tool can improve ROSC results, it cannot be used in certain cases, such as when the patient has an anatomical disorder due to a chest injury. (Seewald et al. 2019).

In this study, not all articles mentioned that the Automatic RJP tool produces better ROSC compared to manual RJP. Therefore, the benefits of the Automated CPR Tool may not be on the patient survival benefits but allow the team to focus their attention on other aspects of resuscitation, such as airway management, vascular access, and addressing the causes of reversible apnea, especially on systems with limitations. personnel (Mastenbrook et al. 2022).

b. ROSC / Spontaneous Circulation Return

From the previous paragraph, it can be concluded that the benefits of using the automatic RJP tool are not superior to manual RJP. There are several conditions that make the automatic RJP tool more useful, such as when transporting and when the RJP lasts for a long time.

3 (three) journal articles whose results favored the automatic CPR tool stated that the automatic CPR tool was more effective than the manual CPR in achieving ROSC, especially in patients with witnessed heart attacks, non-shockable rhythms, and short EMS response times. These findings support the importance of early EMS activation and high-quality early RJP at the pre-hospital stage (Chen et al. 2021; Crowley et al. 2020; Seewald et al. 2019).

Meanwhile, 2 journal articles mentioned that the use of automatic CPR tools gave

worse results in ROSC and using manual CPR was better. The use of mechanical CPR devices in the scene is impractical and often causes chest compression disturbances for 20 to 30 seconds (or longer).

In fact, the use of mechanical CPR is associated with lower survival rates after discharge, ROSC, and outcome measures among others. These findings were consistent across the analysis (Gonzales et al. 2019; Newberry et al. 2018).

c. Injuries in the Management of Cardiac Arrest with Automated RCP Devices

The mortality rate after 30 days is much higher in patients assisted using automated CPR tools (Karasek et al. 2021). An increase in trauma rates is often associated with chest compressions with mechanical CPR tools rather than manual. Trauma can be life-threatening and/or can cause injury when combined with medical interventions such as antithrombotic therapy and anticoagulants, which can lead to fatal injuries to the victim. (Karasek et al. 2021).

The most common injury was fracture with 478 (85.5%) in the manual group compared to 56 (87.5%) in the mechanical group (Karasek et al. 2021).

CONCLUSIONS

The use of automatic CPR tools does not give better results than the overall manual CPR for ROSC, but the use of automatic CPR tools is very useful and meaningful in certain conditions such as during the transportation process, therefore the use of automatic CPR tools is more meaningful. for pre-hospital use. The use of automated CPR equipment carries a very high risk of injury, with fractures topping the list.

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room/fact-sheets/detail/adolescent-mentalhealth

Table 1. Article Search Results

No	Penulis, Tahun	Judul	Metode (Desain, Sampel, Variabel, Instrumen, Analisis)	Hasil	Database
1	Li Luo, Xiao Dong Zhang, Tao Xiang, Hang Dai, Ji Mei Zhang, Guang Ying Zhuo, Yu Fang Sun, Xiao Jun Deng, Wei Zhang and Ming Du, 2021	Early Mechanical Cardiopulmonary resuscitation can improve outcomes in patients with non traumatic cardiac arrest in the emergency department	D: Retrospective Observational Study S: 68 Cardiac Arrest Patients from May 2018 – December 2019 V: ROSC I: Lucas Automatic CPR Device A: Data are presented with the standard deviation of the mean and compared using the t test. Categorical data were presented as percentages or levels and compared with the v2 test. SPSS software (version 15.0; SPSS Inc., Chicago, IL, USA) was used for analysis. P<0.05 indicates statistical significance.	The ROSC rate was higher in group 1 vs group 2 (69.2% vs 52.4%, respectively). The 4-hour survival rate was significantly higher in the early vs late group (83.3% vs 45.5%, respectively), and the duration of CPR was significantly shorter in the early group.	Proquest
2	Stephan Seewald, Manuel Obermaier, Rolf Lefering, Andreas Bohn, Michael Georgieff, Claus-Martin Muth, Jan-Thorsten Graßner, Siobhán Masterson, Jens Scholz, Jan Wnent, 2019	Application of mechanical Cardiopulmonary resuscitation devices and their value in out-of-hospital cardiac arrest: A retrospective analysis of the German Resuscitation Registry	S: 19,609 Cardiac Arrest Patients from 2007-2014 V: ROSC I: Lucas and Autopulse Automatic CPR Devices A: Multivariate logistic regression analysis, odds ratio for ROSC was 1.27 (95%-CI 1.09-1.48) with mechanical vs manual CPR. After adjusting for CPR duration, the model showed a significant benefit for mechanical CPR over manual CPR (OR 1.77 (95%-CI 1.48-2.12) for mechanical CPR).	ROSC was achieved in 51.5% of the mechanical CPR group (95%-CI 48.2–54.8%, expected ROSC 42.5%) and in 41.2% in the manual CPR group (95%-CI 40.4–41.9%, expected ROSC 39.2%). After multivariate adjustment, mechanical CPR was found to be an independent predictor of ROSC (OR 1.77; 95%-CI 1.48-2.12). The duration of CPR is the main determinant of achieving ROSC.	Proquest
3	Joshua Mastenbrook, Kathryn E. Redinger, Duncan Vos, Cheryl Dickson, 2022	Retrospective Comparison of Prehospital Sustained Return of Spontaneous Circulation (ROSC) Rates Within a Single Basic Life Support Jurisdiction Using Manual vs Lund University Cardiac Assist System (LUCAS-2) Mechanical Cardiopulmonary Resuscitation	D: Retrospective Analysis Study S: 264 Cardiac Arrest Patients from July 2011 – October 2017 V: ROSC I: Lucas Automatic CPR Device A: Chi-square analysis was used to assess the impact of the introduction of the LUCAS-2 device by comparing the incidence of ROSC achieved in OHCA using manual chest compressions. Logistic regression models were used to assess the association of independent variables with prehospital ROSC	ROSC rates were 29.7% (22/74) and 29.5% (56/190), respectively, for manual CPR alone and LUCAS-assisted CPR (p=0.9673). Logistic regression revealed a significant association between ROSC and two independent variables: presence of witness (OR 3.104; 95% CI 1.896-5.081; p<0.0001) and shockable rhythm (OR 2.785; 95% CI 1.492-5.199; p<0, 0013).	Proquest

			achievement		
4	Peter A. Kahn, Sanket S. Dhruva, Taeho Greg Rhee, Joseph S. Ross., 2019	Use of Mechanical Cardiopulmonary Resuscitation Devices for Out-of-Hospital Cardiac Arrest, 2010-2016	D: Retrospective Cross-sectional Study S: 892,022 Cardiac Arrest Patients from 2010 – 2016 V: Discharge to Hospital I: Automatic CPR Tool A: We use descriptive statistics to characterize the patient sample. Chi Square Tests were used to compare demographic and geographic characteristics. Logistic regression analysis multivariable corrected for nonindependent observations within EMS agencies	we found that 87.6% of patients who received manual CPR were transferred by EMS to a hospital for further treatment and 0.4% died before transfer, whereas 91.3% of patients who received mechanical CPR were transferred by EMS to a hospital for further treatment. advanced and 0.3% died before transfer; among patients receiving mechanical CPR, the proportion taken to hospital increased statistically, but only slightly, from 0.5% in 2010 to 91.8% in 2016.	PubMed
5	Yi-Rong Chen, Chi-Jiang Liao, Han-Chun Huang, Cheng-Han Tsai, Yao-Sing Su, Chung-Hsien Liu, Chi-Feng Hsu, and Ming-Jen Tsai, 2021	The Effect of Implementing Mechanical Cardiopulmonary Resuscitation Devices on Out-of-Hospital Cardiac Arrest Patients in an Urban City of Taiwan	D: Cohort Retrospective S: 552 Out-of-Hospital Cardiac Arrest Patients V: ROSC I: Automatic CPR Tool A: Data of included OHCA patients were described and compared between the two groups, with and without the use of mechanical CPR. For continuous variables, Student's t-test or Mann-Whitney U test was used, according to data distribution. For categorical variables, the chi-square test was used. To evaluate the net effect of mechanical CPR on patient outcomes, forward stepwise logistic regression analysis was performed, with adjustment for variables with a p value <0.1	Of 552 patients with OHCA, 279 received mechanical CPR and 273 receive manual CPR, before going to the hospital. Mechanical CPR was independently associated with achieving ROSC (OR = 1.871; 95% CI: 1.195–2.930) and sustained (24 hours) ROSC (OR = 2.353; 95% CI: 1.427–3.879). Subgroup analysis showed that mechanical CPR was beneficial in shorter emergency medical services response times (<4 minutes), cardiac arrest witnesses, and nonshockable heart rhythms.	PubMed
6	Hyun Tae Kim, Jae Guk Kim, Yong Soo Jang, Gu Hyun Kang, Wonhee Kim, Hyun Young Choi, Gwang Soo Jun, 2019	Comparison of in-hospital use of mechanical chest compression devices for out-of-hospital cardiac arrest patients	D: Observational Retrospective S: 820 Out-of-Hospital Cardiac Arrest Patients V: ROSC I: Autopulse and LUCAS Automatic CPR Tools A: Univariate analysis, Mann-Whitney U test was used to compare continuous variables and chisquare or Fisher exact test for categorical variables. To identify predictors of outcome, the effects of statistically significant	LUCAS demonstrated inferior survival than AUTOPULSE (OR, 0.23; 95% CI, 0.06-0.84), although it did not show a significant association with ROSC. Percutaneous coronary intervention (OR, 6.30; 95% CI, 1.53-25.95) and target temperature management (TTM; OR, 7.30; 95% CI, 2.27-23.49) were independent factors to survive. In the	PubMed

			covariates after PSM were evaluated with adjusted odds ratios from multivariate logistic regression. P value < 0.05.	witnessed subgroup, female (OR, 0.46; 95% CI, 0.24-0.89) was a prognostic factor for ROSC and shockable rhythm (OR, 5.04; 95% CI, 1.00-25.30), percutaneous coronary intervention (OR, 12.42; 95% CI, 2.04-75.53), and TTM (OR, 9.03; 95% CI, 1.86-43.78) for survival. In the unknown subgroup, no prognostic factors were found for ROSC, and TTM (OR, 99.00; 95% CI, 8.9-110.62) was found to be an independent factor for survival.	
7	J. Karaseka, A. Blankovab, A. Doubkovác, T.Pitasovac, D. Nahalkac, T. Bartesc, J. Hladikd, T. Adamekb, T. Jirasekb, R. Polaseka, P. Ostadale, 2021	The comparison of cardiopulmonary resuscitation-related trauma: Mechanical versus manual chest compressions	D: Retrospective Analysis Study S: 820 Out-of-Hospital Cardiac Arrest Patients V: Trauma After Mechanical CPR I: Automatic CPR Tool A: Continuous variables were compared using no t-test pair two Student choices. Differences with p<0.05 were considered statistically significant. Logistic regression was used to identify variables independently associated with trauma.	Manual CPR was performed on 559 patients and mechanical on 64 subjects. No differences were found in the incidence of CPR-related injuries between groups. Our results showed that mechanical chest compressions did not increase the incidence and severity of CPR-related injuries compared with manual methods despite the significantly longer duration of CPR.	PubMed
8	Ryan Newberry, Ted Redman, Elliot Ross, Rachel Ely, Clayton Saidler, Allyson Arana, David Wampler, David Miramontes, 2018	No Benefit In Neurologic Outcomes Of Survivors Of Out-Of-Hospital Cardiac Arrest With Mechanical Compression Device	D: Retrospective Analysis Study S: 820 Out-of-Hospital Cardiac Arrest Patients V: Neurological Results After Mechanical CPR I: Automatic CPR Tool A: Descriptive statistics were produced, and chi-square tests and t-tests were performed to determine differences between the mechanical and standard CPR groups. Multivariate logistic regression models were used to adjust for the effects of possible confounders and Utstein variables on survival outcomes. Statistical significance was defined as p < 0.05 and 95% confidence intervals were obtained when appropriate	2,236 received manual CPR and 763 used mechanical CPR devices during resuscitation. ROSC was achieved in 44% (334/763) of mechanical CPR resuscitations and in 46% (1,020/2,236) of standard manual CPR resuscitations (p= 0.32). Survival to hospital discharge was observed in 7% (52/763) of the mechanical CPR resuscitation and 9% (191/2,236) of the manual CPR group (p = 0.13). Discharge with a CPC score of 1 or 2 was observed in 4% (29/763) of the mechanical CPR resuscitation group and 6% (129/2,236) of the	PubMed

				manual CPR group (p = 0.036).	
9	Louis Gonzalesa, Brandon K. Oylerb, Jeff L. Hayesa, Mark E. Escotta, Jose G. Cabanasc, Paul R. Hincheyc, Lawrence H. Brown, 2019	Out-of-Hospital Cardiac Arrest Outcomes with "Pit Crew" Resuscitation and Scripted Initiation of Mechanical CPR	D: Retrospective Analysis Study S: 444 out-of-hospital cardiac arrest patients V: ROSC I: Automatic CPR Device A: Chi-square and Wilcoxon rank sum tests, as appropriate, were used to compare characteristics across mechanical and manual CPR cohorts. Multivariable logistic regression combines variables known to be associated with cardiac arrest outcomes	Of the 444 eligible OHCA, 217 received manual and 227 received mechanical CPR. Crude ROSC (39.2% vs 29.1%) and survival to discharge (13.8% vs 5.7%) were higher with manual CPR. In propensity-matched analysis (n = 176 manual CPR; 176 mechanical CPR), both ROSC (38.6% vs. 28.4%; difference: 0.2%; CI: 0.4% to 20.0%) and Survival to discharge (13.6% vs. 6.8%; difference: 6.8%; CI: 0.5% to 13.3%) remained significantly higher for patients who received manual CPR	PubMed
10	Conor P. Crowley, Emily S. Wan, Justin D. Saliccioli, Edy Kim, 2020	The Use of Mechanical Cardiopulmonary Resuscitation May Be Associated With Improved Outcomes Over Manual Cardiopulmonary Resuscitation During Inhospital Cardiac Arrests	D: Retrospective Analysis Study S: 104 Cardiac Arrest Patients V: ROSC I: Automatic CPR Device A: Chi-square/Fisher's test was performed for univariate data to determine the relationship between CPR method, ROSC, and survival. Multivariable logistic regression models were created to assess the possibility of potential confounding variables	59 patients received mechanical CPR and 45 manual. ROSC was 83% in mechanical CPR versus 48.8% in the manual group (p = 0.009). The survival-to-discharge rate was 32.2% for mechanical CPR versus 11.1% for manual (p = 0.02). Of the patients who survived to discharge and received mechanical CPR, 100% (n = 19) had a good neurologic outcome versus 40% (two of five) of patients who survived and received manual cardiopulmonary resuscitation (p = 0.005).	PubMed