Mekanik KPR Cihazları

Doç.Dr.Meltem AKKAŞ
Hacetttepe Üniversitesi Acil Tıp Anabilim Dalı

Mekanik KPR, Manuel KPR?

Neden Mekanik KPR Cihazları?

Kardiyak arrest sonrası yaşam olasılığını arttıran faktörler:

- Kardiyak arrestin erken tanınması
- Etkili KPR ve erken defibrilasyon
- Resüsitasyon sonrası bakım

Yüksek Kalitede KPR Yaşam Şansını Arttırır.

- Manuel KPR çoğunlukla kalite standardının altındadır [1,2]
- Manual kompresyonlar ile normale göre %30 oranında kardiyak output sağlanır
- Uygulayıcılar, genellikle yorulduklarının ve KPR kalitesinin azaldığının farkında değildir [3]
- Özellikle ambulans ile nakil edilen hastalar, zayıf kalitede ve kesintili KPR riski altındadır [3]

[1] Olasveengen TM, Wik L, Steen PA. Quality of cardiopulmonary resuscitation before and during transport in out-of-hospital cardiac arrest. Resuscitation 2008;76:185–90.7.

[2]Wik L, Kramer-Johansen J, Myklebust H, et al. Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest. JAMA 2005;293:299–304.8.

[3]Hightower D, Thomas SH, Stone CK, et al. Decay in quality of closed-chest compressions over time. Ann Emerg Med 1995;26:300–3.

Mekanik KPR Cihazlarının Etkinliği ?

Mekanik KPR: Tarihsel Gelişim

1908 Prof Dr Kessler tarafından geliştirilen mekanik KPR cihazı, Pike ve ark. tarafından köpek resüsitasyonunda kullanıldı.

1960- Sert bir zemine/sedyeye monte, ortasında kompresyon yapan piston

Yelek KPR cihazları (kompresyon hız ve derinlik ayarı)

Mekanik piston cihazları

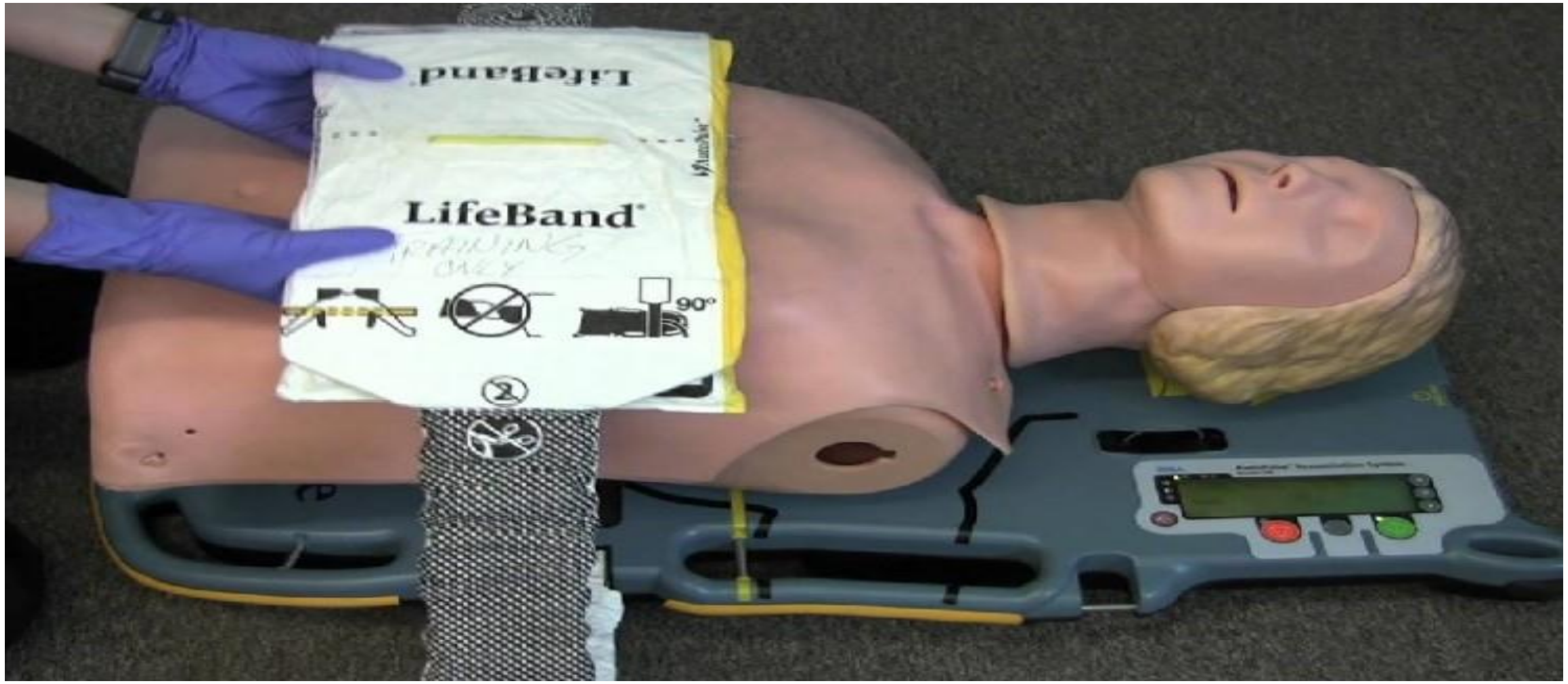
Göğüs ve abdominal kompresyon cihazları


THUMPER
↑HEAD↑
LifeBand
AutoPulse
ZOLL
LUCAS 2
LUCAS™

KPR Yelek (Yük Dağıtıcı Bant)

Toraksın etrafını saran kapalı bir yelek

Ritmik olarak iner ve şişer



Mekanik Piston Cihazlar

Sırt tahtası ve kompresyon uygulayan parça

AHA 2015 KPR Kılavuzu

- Öneriler piston cihazlar ve yük dağıtıcı bant için yapıldı
- Mekanik KPR cihazlarının rutin kullanımı önerilmiyor.
- Mekanik KPR cihazları eğitimli personel varlığında mantıklı bir alternatif olabilir

Class IIb, LOE B-R

- Yüksek kalitede göğüs kompresyonlarının yapılamadığı ya da kurtarıcı güvenliğinin tehlikede olduğu özel durumlarda, cihazın uygulaması ve çıkarılmasına bağlı kesintiler minimalize edilerek kullanılabilir.

-Kısıtlı kurtarıcı

-Uzamış KPR

-Hipotermik kardiyak arrest

-Ambulans ile nakil

-Anjiyografi

-EKPR

Class IIb, LOE B-R

ERC 2015 Resüsitasyon Kılavuzu

- Otomatik mekanik göğüs kompresyon cihazlarının, manuel göğüs kompresyonları yerine rutin kullanımı önerilmiyor.
- Manuel kompresyonların yüksek kalitede yapılamayacağı bazı durumlarda mekanik KPR kullanılabilir

  -Hareket eden ambulans

  -Uzamış KPR (hipotermik arrest)

  -Bazı prosedürler sırasında KPR (koroner anjiyografi, EKPR)

Resuscitation 85 (2014) 741–748

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

Manual vs. integrated automatic load-distributing band CPR with equal survival after out of hospital cardiac arrest. The randomized CIRC trial☆,☆☆

Lars Wik[a,*], Jan-Aage Olsen[a,b], David Persse[c], Fritz Sterz[d], Michael Lozano Jr.[e,f], Marc A. Brouwer[g], Mark Westfall[h,i], Chris M. Souders[c], Reinhard Malzer[j], Pierre M. van Grunsven[k], David T. Travis[e], Anne Whitehead[l], Ulrich R. Herken[m], E. Brooke Lerner[n]

[a] Norwegian Center for Prehospital Emergency Care, Oslo University Hospital, Oslo, Norway
[b] Institute of Clinical Medicine, University of Oslo, Oslo, Norway
[c] Houston Fire Department and the Baylor College of Medicine, Houston, TX, United States
[d] Department of Emergency Medicine, Medical University of Vienna, Vienna, Austria
[e] Hillsborough County Fire Rescue, Tampa, FL, United States
[f] Department of Emergency Medicine, Lake Erie College, Bradenton, FL, United States
[g] Heart Lung Center, Department of Cardiology, Radboud University Medical Center, Nijmegen, The Netherlands
[h] Gold Cross Ambulance Service, Appleton Neenah-Menasha and Grand Chute Fire Departments, WI, United States
[i] Theda Clark Regional Medical Center, Neenah, WI, United States
[j] Wiener Rettung, Municipal ambulance service of Vienna, Vienna, Austria
[k] Regional Ambulance Service Gelderland-Zuid, Nijmegen, The Netherlands
[l] Medical and Pharmaceutical Statistics Research Unit, Department of Mathematics and Statistics, Fylde College, Lancaster University, Lancaster, United Kingdom
[m] ZOLL Medical Corporation, Chelmsford, MA, United States
[n] Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI, United States

ARTICLE INFO

Article history:
Received 20 January 2014
Received in revised form 7 March 2014
Accepted 7 March 2014

Keywords:
Cardiac arrest
Cardiopulmonary resuscitation
Survival
Load distributing band

ABSTRACT

Objective: To compare integrated automated load distributing band CPR (iA-CPR) with high-quality manual CPR (M-CPR) to determine equivalence, superiority, or inferiority in survival to hospital discharge.

Methods: Between March 5, 2009 and January 11, 2011 a randomized, unblinded, controlled group sequential trial of adult out-of-hospital cardiac arrests of presumed cardiac origin was conducted at three US and two European sites. After EMS providers initiated manual compressions patients were randomized to receive either iA-CPR or M-CPR. Patient follow-up was until all patients were discharged alive or died. The primary outcome, survival to hospital discharge, was analyzed adjusting for covariates, (age, witnessed arrest, initial cardiac rhythm, enrollment site) and interim analyses. CPR quality and protocol adherence were monitored (CPR fraction) electronically throughout the trial.

Results: Of 4753 randomized patients, 522 (11.0%) met post enrollment exclusion criteria. Therefore, 2099 (49.6%) received iA-CPR and 2132 (50.4%) M-CPR. Sustained ROSC (emergency department admittance), 24 h survival and hospital discharge (unknown for 12 cases) for iA-CPR compared to M-CPR were 600 (28.6%) vs. 689 (32.3%), 456 (21.8%) vs. 532 (25.0%), 196 (9.4%) vs. 233 (11.0%) patients, respectively. The adjusted odds ratio of survival to hospital discharge for iA-CPR compared to M-CPR, was 1.06 (95% CI 0.83–1.37), meeting the criteria for equivalence. The 20 min CPR fraction was 80.4% for iA-CPR and 80.2% for M-CPR.

Conclusion: Compared to high-quality M-CPR, iA-CPR resulted in statistically equivalent survival to hospital discharge.

Original Investigation

Mechanical Chest Compressions and Simultaneous Defibrillation vs Conventional Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest
The LINC Randomized Trial

Sten Rubertsson, MD, PhD; Erik Lindgren, MD; David Smekal, MD, PhD; Ollie Östlund, PhD; Johan Silfverstolpe, MD; Robert A. Lichtveld, MD, PhD; Rene Boomars, MPA; Björn Ahlstedt, MD; Gunnar Skoog, MD; Robert Kastberg, MD; David Halliwell, RN; Martyn Box, RN; Johan Herlitz, MD, PhD; Rolf Karlsten, MD, PhD

IMPORTANCE A strategy using mechanical chest compressions might improve the poor outcome in out-of-hospital cardiac arrest, but such a strategy has not been tested in large clinical trials.

OBJECTIVE To determine whether administering mechanical chest compressions with defibrillation during ongoing compressions (mechanical CPR), compared with manual cardiopulmonary resuscitation (manual CPR), according to guidelines, would improve 4-hour survival.

DESIGN, SETTING, AND PARTICIPANTS Multicenter randomized clinical trial of 2589 patients with out-of-hospital cardiac arrest conducted between January 2008 and February 2013 in 4 Swedish, 1 British, and 1 Dutch ambulance services and their referring hospitals. Duration of follow-up was 6 months.

INTERVENTIONS Patients were randomized to receive either mechanical chest compressions (LUCAS Chest Compression System, Physio-Control/Jolife AB) combined with defibrillation during ongoing compressions (n = 1300) or to manual CPR according to guidelines (n = 1289).

MAIN OUTCOMES AND MEASURES Four-hour survival, with secondary end points of survival up to 6 months with good neurological outcome using the Cerebral Performance Category (CPC) score. A CPC score of 1 or 2 was classified as a good outcome.

RESULTS Four-hour survival was achieved in 307 patients (23.6%) with mechanical CPR and 305 (23.7%) with manual CPR (risk difference, −0.05%; 95% CI, −3.3% to 3.2%; $P > .99$). Survival with a CPC score of 1 or 2 occurred in 98 (7.5%) vs 82 (6.4%) (risk difference, 1.18%; 95% CI, −0.78% to 3.1%) at intensive care unit discharge, in 108 (8.3%) vs 100 (7.8%) (risk difference, 0.55%; 95% CI, −1.5% to 2.6%) at hospital discharge, in 105 (8.1%) vs 94 (7.3%) (risk difference, 0.78%; 95% CI, −1.3% to 2.8%) at 1 month, and in 110 (8.5%) vs 98 (7.6%) (risk difference, 0.86%; 95% CI, −1.2% to 3.0%) at 6 months with mechanical CPR and manual CPR, respectively. Among patients surviving at 6 months, 99% in the mechanical CPR group and 94% in the manual CPR group had CPC scores of 1 or 2.

CONCLUSIONS AND RELEVANCE Among adults with out-of-hospital cardiac arrest, there was no significant difference in 4-hour survival between patients treated with the mechanical CPR algorithm or those treated with guideline-adherent manual CPR. The vast majority of survivors in both groups had good neurological outcomes by 6 months. In clinical practice, mechanical CPR using the presented algorithm did not result in improved effectiveness compared with manual CPR.

Author Affiliations: Author affiliations are listed at the end of this article.

Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial

*Gavin D Perkins, Ranjit Lall, Tom Quinn, Charles D Deakin, Matthew W Cooke, Jessica Horton, Sarah E Lamb, Anne-Marie Slowther, Malcolm Woollard, Andy Carson, Mike Smyth, Richard Whitfield, Amanda Williams, Helen Pocock, John J M Black, John Wright, Kyee Han, Simon Gates, PARAMEDIC trial collaborators**

Summary

Background Mechanical chest compression devices have the potential to help maintain high-quality cardiopulmonary resuscitation (CPR), but despite their increasing use, little evidence exists for their effectiveness. We aimed to study whether the introduction of LUCAS-2 mechanical CPR into front-line emergency response vehicles would improve survival from out-of-hospital cardiac arrest.

Methods The pre-hospital randomised assessment of a mechanical compression device in cardiac arrest (PARAMEDIC) trial was a pragmatic, cluster-randomised open-label trial including adults with non-traumatic, out-of-hospital cardiac arrest from four UK Ambulance Services (West Midlands, North East England, Wales, South Central). 91 urban and semi-urban ambulance stations were selected for participation. Clusters were ambulance service vehicles, which were randomly assigned (1:2) to LUCAS-2 or manual CPR. Patients received LUCAS-2 mechanical chest compression or manual chest compressions according to the first trial vehicle to arrive on scene. The primary outcome was survival at 30 days following cardiac arrest and was analysed by intention to treat. Ambulance dispatch staff and those collecting the primary outcome were masked to treatment allocation. Masking of the ambulance staff who delivered the interventions and reported initial response to treatment was not possible. The study is registered with Current Controlled Trials, number ISRCTN08233942.

Findings We enrolled 4471 eligible patients (1652 assigned to the LUCAS-2 group, 2819 assigned to the control group) between April 15, 2010 and June 10, 2013. 985 (60%) patients in the LUCAS-2 group received mechanical chest compression, and 11 (<1%) patients in the control group received LUCAS-2. In the intention-to-treat analysis, 30 day survival was similar in the LUCAS-2 group (104 [6%] of 1652 patients) and in the manual CPR group (193 [7%] of 2819 patients; adjusted odds ratio [OR] 0·86, 95% CI 0·64–1·15). No serious adverse events were noted. Seven clinical adverse events were reported in the LUCAS-2 group (three patients with chest bruising, two with chest lacerations, and two with blood in mouth). 15 device incidents occurred during operational use. No adverse or serious adverse events were reported in the manual group.

Interpretation We noted no evidence of improvement in 30 day survival with LUCAS-2 compared with manual compressions. On the basis of ours and other recent randomised trials, widespread adoption of mechanical CPR devices for routine use does not improve survival.

Funding National Institute for Health Research HTA – 07/37/69.

Lancet 2015; 385: 947–55

Published Online November 16, 2014 http://dx.doi.org/10.1016/S0140-6736(14)61886-9

See Comment page 920

*Collaborators listed at end of paper

Warwick Clinical Trials Unit, University of Warwick, Coventry, UK (Prof G D Perkins MD, R Lall PhD, Prof M W Cooke PhD, J Horton MSc, Prof S E Lamb DPhil, A-M Slowther DPhil, M Smyth MSc, Prof S Gates PhD); **Heart of England NHS Foundation Trust, Birmingham, UK,** (Prof G D Perkins); **Surrey Peri-operative Anaesthesia Critical care collaborative Research Group, Faculty of Health and Medical Sciences, University of Surrey, Guildford, UK** (Prof T Quinn M Phil, Prof M Woollard MPH, Prof C D Deakin MD); **South Central Ambulance Service NHS Foundation Trust, Otterbourne, UK** (Prof C D Deakin, H Pocock MSc, J J M Black FCEM); **NIHR Southampton Respiratory Biomedical Research Unit, University Hospital Southampton NHS Foundation**

	CIRC	LINC	PARAMEDIC
Lokalizasyon	ABD/Avrupa	Avrupa	İngiltere
Yıl	2009-2011	2008-2013	2010-2013
Randomizasyon	Randomize	Multicenter-randomize	Randomize
Cihaz	AutoPulse	LUCAS	LUCAS
Hasta sayısı	4231 %49.6 mKPR	2589	4470
Sponsor	Endüstri	Endüstri	Akademik
Birincil sonlanım mKPR/manuel KPR	Hastaneden taburculuk Fark yok	4 saaat yaşam Fark yok	30 gün yaşam Fark yok Subgrup: VF/Nabızsız VT de yaşam mekanik KPR ile daha düşük

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

EUROPEAN RESUSCITATION COUNCIL

Mechanical chest compression devices are associated with poor neurological survival in a statewide registry: A propensity score analysis☆,☆☆

Scott T. Youngquist[a,b,*], Patrick Ockerse[a], Sydney Hartsell[c], Chris Stratford[a], Peter Taillac[a,d]

[a] University of Utah School of Medicine, Division of Emergency Medicine, Salt Lake City, UT, United States
[b] The Salt Lake City Fire Department, Salt Lake City, UT, United States
[c] The University of North Carolina School of Medicine, Chapel Hill, NC, United States
[d] The Utah Department of Health, Bureau of Emergency Medical Services, United States

- 1 Mayıs 2012-18 Haziran 2015
- 2600 HDKA vakası ile yapılan gözlemsel kohort çalışması
- %16 mekanik KPR (%92 Autopulse, %5 LUCAS, %3 diğer)
- Mekanik KPR uygulanan vakalarda, şahitli arrest, şok verilebilen ilk ritim daha az, asistoli , ALS ilaç kullanımı daha fazla
- Eğilim skor analizlerinde, mekanik KPR daha düşük fonksiyonel yaşam ile ilişkili
- (%4 mekanik KPR - %11 manuel KPR, RR 0.41 %95 Cl 0.24-0.70, p=0.001)
- İlk ritim, şok verilebilir bir ritim ise, mekanik KPR kötü sonuçlar ile ilişkili bulundu

Resuscitation 106 (2016) 102–107

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Mechanical chest compression devices are associated with poor neurological survival in a statewide registry: A propensity score analysis☆,☆☆

Scott T. Youngquist[a,b,*], Patrick Ockerse[a], Sydney Hartsell[c], Chris Stratford[a], Peter Taillac[a,d]

Results of multilevel mixed-effects Poisson regression comparing the outcome of neurologically-intact survival to hospital discharge among cardiac arrest victims who received mechanical vs. manual chest compressions (CC) by EMS while controlling for additional predictors of outcome.

Variable	Adjusted relative risk	(95% confidence interval)	p value
Mechanical CC vs. manual CC	0.56	(0.34–0.94)	0.028
Age (years)	0.985	(0.98–0.99)	<0.0001
Male gender	1.00	(0.76–1.34)	0.97
Public location	1.17	(0.87–1.57)	0.30
Bystander witnessed	1.55	(1.15–2.10)	0.005
EMS witnessed	1.34	(0.89–2.04)	0.16
Bystander CPR	0.97	(0.71–1.33)	0.86
Bystander AED shock	1.10	(0.74–1.62)	0.64
Shockable initial rhythm	3.51	(2.62–4.71)	<0.0001
Advanced life support medications administered	1.12	(0.81–1.56)	0.50
Early return of spontaneous circulation[a]	4.84	(3.53–6.62)	<0.0001
Advanced airway placed	0.61	(0.47–0.80)	<0.0001

[a] Defined as field ROSC occurring after either a bystander AED shock, EMS CPR only, or after an EMS defibrillator shock

Results of subgroup/sensitivity analyses comparing the outcome of neurologically intact survival to hospital discharge among cardiac arrest victims who received mechanical vs. manual chest compressions (CC) by EMS among subgroups using a propensity score approach.

	Relative risk	(95% confidence interval)	p value
All cases	0.41	(0.24–0.70)	0.001
By initial rhythm			
Shockable	0.47	(0.25–0.86)	0.015
Asystole	0.41	(0.11–1.57)	0.194
PEA[a]	0.24	(0.02–2.26)	0.211
EMS witnessed	0.18	(0.08–0.40)	<0.0001
Early field ROSC[b] excluded	0.53	(0.29–1.0)	0.05
AutoPulse only	0.51	(0.28–0.94)	0.028

[a] Pulseless electrical activity.
[b] Return of spontaneous circulation.

Mechanical Cardiopulmonary Resuscitation and Hospital Survival Among Adult Patients With Nontraumatic Out-of-Hospital Cardiac Arrest Attending the Emergency Department: A Prospective, Multicenter, Observational Study in Japan (SOS-KANTO [Survey of Survivors after Out-of-Hospital Cardiac Arrest in Kanto Area] 2012 Study)

Kei Hayashida, MD, PhD; Takashi Tagami, MD, MPH, PhD; Tatsuma Fukuda, MD, PhD; Masaru Suzuki, MD, PhD; Naohiro Yonemoto, MPH; Yutaka Kondo, MD, PhD; Tomoko Ogasawara, MD; Atsushi Sakurai, MD, PhD; Yoshio Tahara, MD, PhD; Ken Nagao, MD, PhD; Arino Yaguchi, MD, PhD; Naoto Morimura, MD, PhD; on behalf of the SOS-KANTO Study Group*

Background—Mechanical cardiopulmonary resuscitation (mCPR) for patients with out-of-hospital cardiac arrest attending the emergency department has become more widespread in Japan. The objective of this study is to determine the association between the mCPR in the emergency department and clinical outcomes.

Methods and Results—In a prospective, multicenter, observational study, adult patients with out-of-hospital cardiac arrest with sustained circulatory arrest on hospital arrival were identified. The primary outcome was survival to hospital discharge. The secondary outcomes included a return of spontaneous circulation and successful hospital admission. Multivariate analyses adjusted for potential confounders and within-institution clustering effects using a generalized estimation equation were used to analyze the association of the mCPR with outcomes. Between January 1, 2012 and March 31, 2013, 6537 patients with out-of-hospital cardiac arrest were eligible; this included 5619 patients (86.0%) in the manual CPR group and 918 patients (14.0%) in the mCPR group. Of those patients, 28.1% (1801/6419) showed return of spontaneous circulation in the emergency department, 20.4% (1175/5754) had hospital admission, 2.6% (168/6504) survived to hospital discharge, and 1.2% (75/6419) showed a favorable neurological outcome at 1 month after admission. Multivariate analyses revealed that mCPR was associated with a decreased likelihood of survival to hospital discharge (adjusted odds ratio, 0.40; 95% confidence interval, 0.20–0.78; *P*=0.005), return of spontaneous circulation (adjusted odds ratio, 0.71; 95% confidence interval, 0.53–0.94; *P*=0.018), and hospital admission (adjusted odds ratio, 0.57; 95% confidence interval, 0.40–0.80; *P*=0.001).

Conclusions—After accounting for potential confounders, the mCPR in the emergency department was associated with decreased likelihoods of good clinical outcomes after adult nontraumatic out-of-hospital cardiac arrest. Further studies are needed to clarify circumstances in which mCPR may benefit these patients. **(*J Am Heart Assoc*. 2017;6:e007420. DOI: 10.1161/JAHA.117.007420.)**

Key Words: cardiopulmonary resuscitation • emergency department • mechanical chest compression device

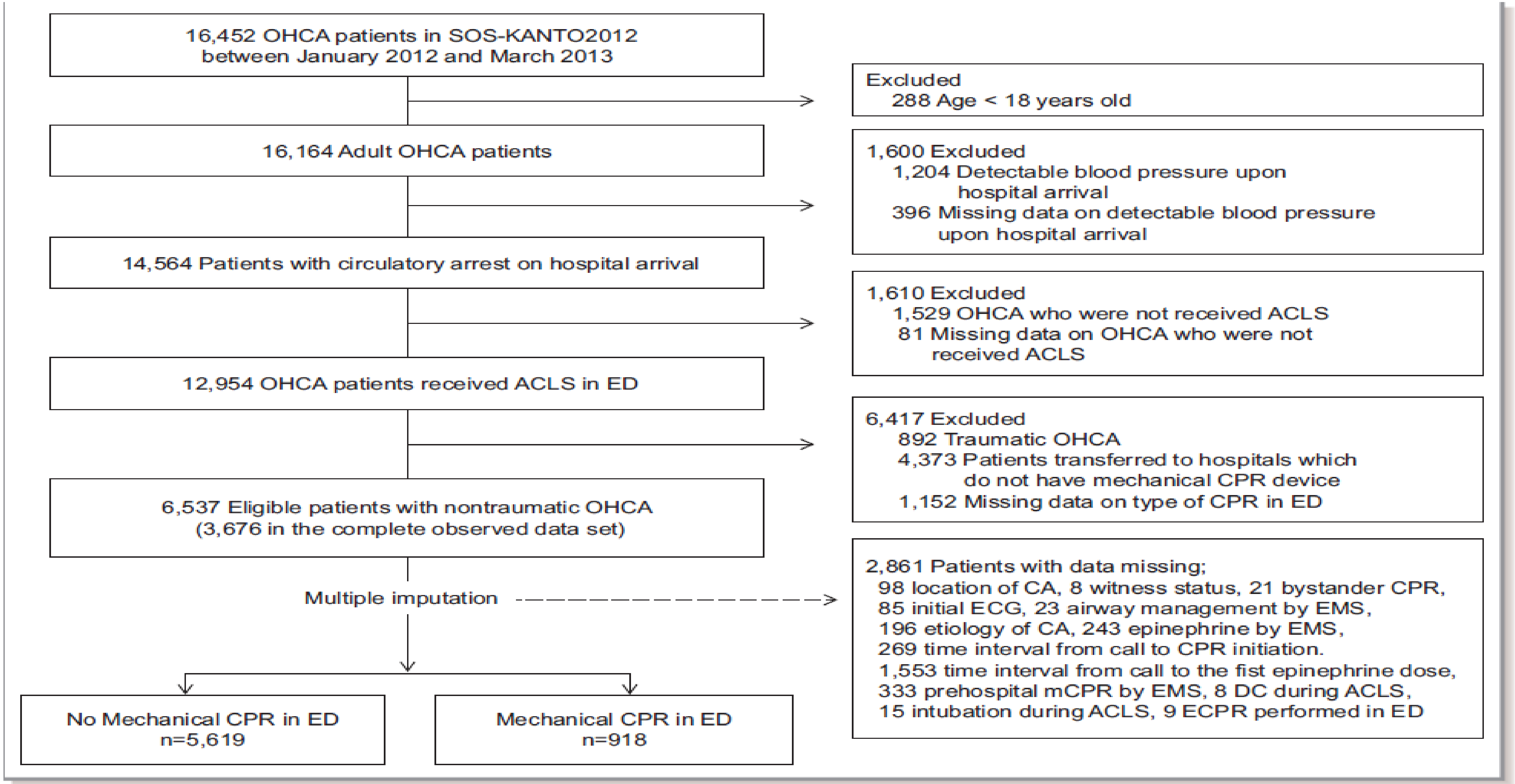


Figure 1. Patient selection. ACLS indicates advanced cardiovascular life support; CA, cardiac arrest; CPR, cardiopulmonary resuscitation; DC, direct current defibrillation; ECPR, extracorporeal CPR; ED, emergency department; EMS, emergency medical service; mCPR, mechanical CPR; OHCA, out-of-hospital CA; and SOS-KANTO, Survey of Survivors after Out-of-Hospital Cardiac Arrest in Kanto Area.

Table 1. Patient, Hospital, and Event Characteristics and Laboratory Data Among Study Patients With Manual CPR vs mCPR

Variable	Manual CPR (n=5619)	mCPR (n=918)	*P* Value
Age, median (IQR), y	75 (63–83)	75 (63–83)	0.523
Male sex	3375 (60.1)	583 (63.5)	0.048
Missing	0 (0)	0 (0)	
Location of cardiac arrest			0.057
Home	3989 (71.0)	619 (67.4)	
Public building	1012 (18.0)	174 (19.0)	
Others	536 (9.6)	109 (11.9)	
Missing	82 (1.5)	16 (1.7)	
No. of institutional use for mCPR device per y			<0.001
<20	4603 (81.9)	110 (12.0)	
20–100	879 (15.6)	224 (24.4)	
>100	137 (2.4)	584 (63.6)	
Observation period			0.552
January–September 2012	3136 (55.8)	522 (56.9)	
October 2012–March 2013	2483 (44.2)	396 (43.1)	
Time of cardiac arrest			0.193
8:00 AM to 9:59 PM	1736 (30.9)	264 (28.8)	
10:00 PM to 7:59 AM	3883 (69.1)	654 (71.2)	
Witnessed status	2653 (47.2)	498 (54.2)	<0.001
Missing	5 (0.1)	3 (0.3)	
Bystander CPR	1870 (33.3)	389 (42.4)	<0.001
Missing	21 (0.4)	0 (0)	
First documented rhythm			<0.001
VF/pulseless VT	397 (7.1)	77 (8.4)	
Asystole/PEA	4855 (86.4)	768 (83.7)	
Others	303 (5.4)	47 (5.1)	
Missing	64 (1.1)	26 (2.8)	
Time interval, median (IQR), min			
Time from call to EMS arrival at scene	7 (6–10)	7 (6–9)	0.202
Missing	1 (0.0)	0 (0.0)	
Time from EMS arrival at scene to EMS arrival at the patient's side	1 (1–2)	1 (1–2)	0.009
Missing	18 (0.3)	2 (0.2)	
Time from EMS arrival at the patient's side to CPR initiation	0 (0–1)	0 (0–1)	0.730
Missing	524 (9.3)	87 (9.5)	
Time from CPR initiation to hospital arrival	25 (19–31)	23 (18–29)	<0.001
Missing	273 (4.9)	52 (5.7)	
Prehospital mCPR by EMS	81 (1.4)	40 (4.4)	<0.001
Missing	545 (9.7)	107 (11.7)	
No. of defibrillations by EMS, median (IQR)	0 (0–0)	0 (0–0)	0.106
Missing	79 (1.4)	22 (2.4)	

Variable	Manual CPR (n=5619)	mCPR (n=918)	*P* Value
Airway management by EMS	5371 (95.6)	869 (94.7)	0.421
Missing	21 (0.4)	5 (0.5)	
Epinephrine use by EMS	1135 (20.2)	175 (19.1)	0.439
Missing	243 (4.3)	47 (5.1)	
Presumed cardiac cause	3142 (55.9)	386 (42.0)	<0.001
Missing	172 (3.1)	38 (4.1)	
Time from call to the first epinephrine dose, median (IQR), min	36 (27–44)	34 (26–42)	0.006
Missing	1587 (28.2)	299 (32.6)	
Defibrillation attempt during ACLS	652 (11.6)	140 (15.3)	<0.001
Missing	9 (0.2)	11 (1.2)	
No. of defibrillations in ED, median (IQR)	0 (0–0)	0 (0–0)	<0.001
Missing	28 (0.5)	16 (1.7)	
Tracheal intubation in ED	5000 (89.0)	832 (90.6)	<0.001
Missing	19 (0.3)	14 (1.5)	
Epinephrine use in ED	4952 (88.1)	890 (96.9)	<0.001
Missing	2 (0)	1 (0.1)	
ECPR performed in ED	138 (2.5)	47 (5.1)	<0.001
Missing	28 (0.5)	10 (1.1)	
Type of mCPR device			
AutoPulse	···	93 (10.1)	
LUCAS or LUCAS2	···	172 (18.7)	
Others	···	570 (62.1)	
Missing	···	83 (9.0)	
Laboratory data on ED arrival, median (IQR)			
Blood ammonia level, μmol/L	282 (151–468)	280 (141–500)	0.982
Missing	3326 (59.2)	292 (31.8)	
Blood pH	6.86 (6.74–6.98)	6.87 (6.73–7.00)	0.442
Missing	703 (12.5)	72 (7.8)	
Blood $PaCO_2$, mm Hg	90 (66–116)	91 (68–113)	0.769
Missing	639 (11.7)	65 (7.1)	

Data are number (percentage) unless otherwise indicated. ACLS indicates advanced cardiovascular life support; CPR, cardiopulmonary resuscitation; ECPR, extracorporeal CPR; ED, emergency department; EMS, emergency medical service; IQR, interquartile range; mCPR, mechanical CPR; PEA, pulseless electrical activity; VF, ventricular fibrillation; and VT, ventricular tachycardia.

Table 2. Association Between mCPR and Primary Outcome

Outcome	Total No. of Patients	Manual CPR, No. (%)	mCPR			
			No. (%)	OR	95% CI	*P* Value
Total	6537	5619 (86.0)	918 (14.0)			
Survival to hospital discharge	6504					
Crude		145 (2.6)	23 (2.5)	0.97	0.62–1.51	0.887
Adjusted for selected variables*				0.43	0.22–0.83	0.012
Adjusted for all variables†				0.40	0.20–0.78	0.005

CI indicates confidence interval; CPR, cardiopulmonary resuscitation; mCPR, mechanical CPR; and OR, odds ratio.

*Generalized estimating equation (GEE) models were used with adjustment for age, sex, hospital category, witnessed status, bystander CPR, first documented rhythm, presumed cardiac cause, airway management by emergency medical service (EMS), prehospital administration of epinephrine by EMS, tracheal intubation during advanced cardiovascular life support, administration of epinephrine, defibrillation attempt, extracorporeal CPR performed in the emergency department, and time from call to EMS arrival at scene, time from EMS arrival at scene to EMS arrival at the patient's side, time from EMS arrival at the patient's side to CPR initiation, and time from CPR initiation to hospital arrival (while also adjusting for within-institution clustering effects).

†Adjustment for all variables and within-institution clustering effects by a GEE model.

Table 3. Associations Between mCPR and Secondary Outcomes

Outcome	Total No. of Patients	Manual CPR, No. (%)	mCPR			
			No. (%)	OR	95% CI	*P* Value
Total	6537	5619 (86.0)	918 (14.0)			
ROSC in the ED	6419					
Crude		1561 (28.3)	240 (26.3)	0.90	0.77–1.06	0.214
Adjusted for selected variables*				0.72	0.54–0.96	0.027
Adjusted for all variables†				0.71	0.53–0.94	0.018
Hospital admission	5754					
Crude		1019 (20.6)	156 (19.3)	0.92	0.76–1.11	0.377
Adjusted for selected variables*				0.57	0.40–0.80	0.001
Adjusted for all variables†				0.57	0.40–0.80	0.001

CI indicates confidence interval; CPR, cardiopulmonary resuscitation; ED, emergency department; mCPR, mechanical CPR; OR, odds ratio; and ROSC, return of spontaneous circulation.
*Generalized estimating equation (GEE) models were used with adjustment for age, sex, hospital category, witnessed status, bystander CPR, first documented rhythm, presumed cardiac cause, airway management by emergency medical service (EMS), prehospital administration of epinephrine by EMS, tracheal intubation during advanced cardiovascular life support, administration of epinephrine, defibrillation attempt, extracorporeal CPR performed in the ED, and time from call to EMS arrival at scene, time from EMS arrival at scene to EMS arrival at the patient's side, time from EMS arrival at the patient's side to CPR initiation, and time from CPR initiation to hospital arrival (while also adjusting for within-institution clustering effects).
†Adjustment for all variables and within-institution clustering effects by a GEE model.

Subgroup	Survival to Hospital Discharge, No. of Patients With Outcome/Total Patients (%) — Manual CPR	Mechanical CPR	Adjusted OR (95%CI)
Sex			
Male	106 / 3356 (3.2)	17 / 582 (2.9)	0.37 (0.16-0.85)
Female	39 / 2233 (1.7)	6 / 333 (1.8)	0.52 (0.20-1.31)
Age			
18-75 yo	106 / 2826 (3.8)	17 / 473 (3.6)	0.42 (0.20-0.90)
>75 yo	39 / 2763 (1.4)	6 / 442 (1.4)	0.39 (0.20-0.77)
Etiology			
Cardiac	92 / 3216 (2.9)	15 / 399 (3.8)	0.40 (0.21-0.77)
Non-cardiac	53 / 2373 (2.2)	8 / 516 (1.6)	0.41 (0.15-1.09)
Time of arrest			
Day	98 / 3857 (2.5)	12 / 651 (1.8)	0.26 (0.16-0.42)
Night	47 / 1732 (2.7)	11 / 264 (4.2)	0.94 (0.31-2.89)
Witnessed status			
Yes	104 / 2635 (3.9)	14 / 497 (2.8)	0.35 (0.14-0.91)
No	41 / 2954 (1.4)	9 / 418 (2.2)	0.79 (0.36-1.75)
Bystander CPR			
Yes	58 / 1866 (3.1)	8 / 388 (2.1)	0.24 (0.07-0.90)
No	87 / 3723 (2.3)	15 / 527 (2.8)	0.71 (0.35-1.44)
Initial rhythm			
Shockable	46 / 391 (1.2)	7 / 78 (0.9)	0.30 (0.09-0.97)
Non-shockable	68 / 4893 (1.3)	11 / 789 (1.4)	0.47 (0.19-1.16)
Others	31 / 305 (10.2)	5 / 49 (10.2)	0.44 (0.15-1.25)
Transfer time			
< 35 min	88 / 2911 (3.0)	19 / 543 (3.5)	0.44 (0.16-1.25)
≥ 35 min	57 /2678 (2.1)	4 / 372 (1.1)	0.38 (0.13-1.09)

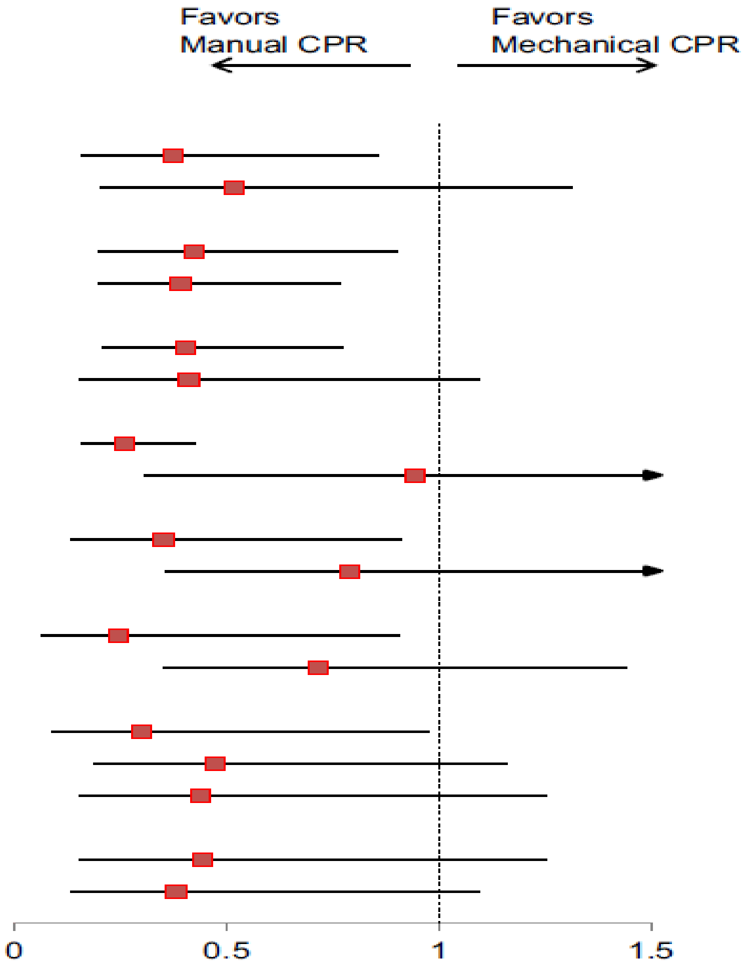


Figure 2. Forest plot of subgroup analyses of survival to hospital discharge. The dotted vertical line represents a risk ratio of 1.0. CI indicates confidence interval; CPR, cardiopulmonary resuscitation; mCPR, mechanical CPR; and OR, odds ratio.

Manual Cardiopulmonary Resuscitation Versus CPR Including a Mechanical Chest Compression Device in Out-of-Hospital Cardiac Arrest: A Comprehensive Meta-analysis From Randomized and Observational Studies

Judith L. Bonnes, MD*; Marc A. Brouwer, MD, PhD; Eliano P. Navarese, MD, PhD; Dominique V. M. Verhaert, BSc; Freek W. A. Verheugt, MD, PhD; Joep L. R. M. Smeets, MD, PhD; Menko-Jan de Boer, MD, PhD

*Corresponding Author. E-mail: judithbonnes@gmail.com or judith.bonnes@radboudumc.nl.

Study objective: Mechanical chest compression devices have been developed to facilitate continuous delivery of high-quality cardiopulmonary resuscitation (CPR). Despite promising hemodynamic data, evidence on clinical outcomes remains inconclusive. With the completion of 3 randomized controlled trials, we conduct a meta-analysis on the effect of in-field mechanical versus manual CPR on clinical outcomes after out-of-hospital cardiac arrest.

Methods: With a systematic search (PubMed, Web of Science, EMBASE, and the Cochrane Libraries), we identified all eligible studies (randomized controlled trials and nonrandomized studies) that compared a CPR strategy including an automated mechanical chest compression device with a strategy of manual CPR only. Outcome variables were survival to hospital admission, survival to discharge, and favorable neurologic outcome.

Results: Twenty studies (n=21,363) were analyzed: 5 randomized controlled trials and 15 nonrandomized studies, pooled separately. For survival to admission, the pooled estimate of the randomized controlled trials did not indicate a difference (odds ratio 0.94; 95% confidence interval 0.84 to 1.05; P=.24) between mechanical and manual CPR. In contrast, meta-analysis of nonrandomized studies demonstrated a benefit in favor of mechanical CPR (odds ratio 1.42; 95% confidence interval 1.21 to 1.67; P<.001). No interaction was found between the endorsed CPR guidelines (2000 versus 2005) and the CPR strategy (P=.27). Survival to discharge and neurologic outcome did not differ between strategies.

Conclusion: Although there are lower-quality, observational data that suggest that mechanical CPR used at the rescuer's discretion could improve survival to hospital admission, the cumulative high-quality randomized evidence does not support a routine strategy of mechanical CPR to improve survival or neurologic outcome. These findings are irrespective of the endorsed CPR guidelines during the study periods. [Ann Emerg Med. 2016;67:349-360.]

Please see page 350 for the Editor's Capsule Summary of this article.

A **feedback** survey is available with each research article published on the Web at www.annemergmed.com.
A **podcast** for this article is available at www.annemergmed.com.

Manual Cardiopulmonary Resuscitation Versus CPR Including a Mechanical Chest Compression Device in Out-of-Hospital Cardiac Arrest: A Comprehensive Meta-analysis From Randomized and Observational Studies

Judith L. Bonnes, MD*; Marc A. Brouwer, MD, PhD; Eliano P. Navarese, MD, PhD; Dominique V. M. Verhaert, BSc; Freek W. A. Verheugt, MD, PhD; Joep L. R. M. Smeets, MD, PhD; Menko-Jan de Boer, MD, PhD

- Toplam 20 çalışma, 21363 HDKA vaka, 9391 mekanik KPR, 11972 manuel KPR
- 5 randomize (yüksek kalite, düşük bias), 15 gözlemsel (iyi-orta kalite) çalışma
- 11 çalışmada AutoPulse, 8 çalışmada LUCAS, bir çalışmada AutoPulse + LUCAS
- Randomize çalışmalarda, hastane kabulünde yaşam oranları, ROSC, hastaneden taburculuk, iyi nörolojik sonuçlarla taburculuk her iki grupta benzer
- Gözlemsel çalışmalarda, mekanik KPR uygulanan hastalarda, hastane kabulünde yaşam oranı %42, ROSC %74 daha fazla. Hastaneden taburculuk ve iyi nörolojik sonuçlarla taburculuk oranları benzer.
- KPR ister mekanik, ister manuel yapılsın, yaşam oranlarında, 2000, 2005, 2010 kılavuzlarına göre bir farklılık tespit edilmedi.

CADTH RAPID RESPONSE REPORT

Mechanical Cardiopulmonary Resuscitation Devices for Cardiac Arrest: Clinical Effectiveness and Cost- Effectiveness

May 23, 2017 **Authors:** Calvin Young, Lory Picheca

- The Canadian Agency for Drugs and Technologies in Health (CADTH) Report
- 1 Ocak 2012- 8 Mayıs 2017
- Toplam 30 çalışma

  -Sağlık teknoloji değerlendirmeleri: 2

  -Sistemik derleme: 10 (7 meta analiz)

  -Randomize kontrollü çalışma: 5

  -Randomize olmayan çalışma: 13

Mekanik KPR, manuel KPR ile karşılaştırıldığında;

1-Daha iyi klinik sonuçlar

13 çalışma (4 sistemik derleme, 2 randomize kontrollü, 7 randomize olmayan)

2-Farklılık yok

10 Çalışma (2 sağlık teknoloji değerlendirmesi, 4 sistemik derleme, 3 randomize kontrollü, 1 randomize olmayan)

3-Daha kötü sonuçlar

7 çalışma (2 sistemik derleme, 5 randomize olmayan çalışma)

4-Yaygın kullanımı için kanıtlar yetersiz

7 çalışma (2 sistemik derleme, 5 randomize olmayan çalışma)

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Health Technology Assessments					
Gates, 2016[1]	• Contains RCT, SR, and economic evaluation evidence	• LUCAS-2 mechanical CPR	• Manual CPR	• 30-day survival • EA	• RCT reported no benefit to 30-day survival with LUCAS-2 over manual CPR
					• SR reported no survival advantage with LUCAS-2 • EA showed that LUCAS-2 was dominated by manual CPR
NICE, 2015[2]	• Assessed clinical effectiveness, safety, and cost	• AutoPulse mechanical CPR device	• Manual CPR	• Survival to hospital discharge • 24-hour survival • 4-hour survival • Cerebral performance • EA	• Majority of included studies reported that outcomes with the AutoPulse device were at least non-inferior compared with manual compression
Systematic Reviews and Meta-Analyses					
Bonnes, 2016[3]	• SR & MA • 20 studies included (5 RCTs, 15 NRS) • N = 21,363	• Mechanical chest compression devices	• Manual chest compression	• Survival to hospital admission • Survival to discharge • Favourable neurologic outcome	• NRS pooling suggested that mechanical CPR devices may offer benefit for survival to admission • No difference observed for survival to discharge or neurological outcome between CPR strategies
Couper, 2016[4]	• SR & MA • 9 studies included • N = 689	• Mechanical chest compression devices	• Manual chest compression	• Survival with good neurological outcome • Survival at hospital discharge • 30-day survival • Short-term survival (ROSC/1-h survival)	• Mechanical chest compression device use led to improved hospital, 30-day, and short-term survival • Quality of reviewed evidence was low
Li, 2016[5]	• SR & MA • 12 studies included • N = 11,162	• Mechanical chest compression devices	• Manual chest compression	• ROSC • Survival to admission and discharge • Neurological function	• No differences between chest compression devices and manual resuscitation in survival to admission.

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
					discharge, and neurology function were observed • Mechanical chest compression devices were inferior in their ability to achieve ROSC; therefore, cannot be recommended to replace manual CPR
Gates, 2015[6]	• SR & MA • 5 studies included • N = NR	• Mechanical chest compression devices	• Manual chest compression	• ROSC • Survival of event • Overall survival • Survival with good neurological outcome	• No evidence that mechanical chest compression devices were superior to manual chest compression for the outcomes studied
Lameijer, 2015[7]	• SR • 14 studies included • N = NR	• Mechanical chest compression devices	• Manual chest compression	• Survival rate • Full neurological recovery	• Early start of mechanical chest compressions may improve patient outcomes over manual chest compressions
Tang, 2015[8]	• SR & MA • 5 studies included • N = 12,510	• Mechanical chest compressions	• Manual chest compressions	• Survival with good neurological outcome • ROSC • Long-term (>/=6 months) survival • Survival to hospital admission • Survival to hospital discharge	• Mechanical chest compression did not significantly improve survival with good neurological outcomes, ROSC, or long-term survival • Mechanical chest compression was inferior for survival to hospital admission and hospital discharge • Widespread use of mechanical compression devices cannot be recommended

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Brooks, 2014[9]	• SR & MA • 6 studies included • N = 1,166	• Mechanical chest compressions	• Manual chest compressions	• Survival to hospital discharge with good neurological outcome • ROSC • Survival to hospital admission	• Insufficient evidence to conclude that mechanical chest compressions during CPR are advantageous to manual chest compressions
Westfall, 2013[10]	• SR & MA • 12 studies included • N = 6,538	• Load-distributing band and piston-driven chest compression devices	• Manual CPR	• ROSC	• ROSC achieved at a higher rate with mechanical compression devices
Gates, 2012[11]	• SR • 16 studies included • N = NR	• LUCAS mechanical chest compression device	• Manual chest compression	• ROSC • Survival • Injuries caused by resuscitation • Physiological parameters	• Human studies did not suggest a clinical advantage for the LUCAS device over manual chest compressions • Insufficient evidence to make recommendations for clinical practice
Ong, 2012[12]	• SR • 10 studies included • N = NR	• Mechanical CPR devices	• Manual CPR	• Quality of CPR • ROSC • Survival • Survival to hospital admission • Survival to discharge • Cerebral performance	• Insufficient evidence regarding the use of mechanical CPR devices for out-of-hospital cardiac arrest and during ambulance transport
Randomized Controlled Trials					
Gao, 2016[13]	• N = 133	• AutoPulse automated chest compression device	• Manual chest compression	• ROSC • 24-hour survival • Hospital discharge rate • Cerebral performance	• AutoPulse device increases rate of ROSC and survival in patients with out-of-hospital cardiac arrest

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Esibov, 2015[14]	• N = 206	• LUCAS mechanical chest compression device	• Manual chest compression	• Chest compression fraction (the fraction of time during cardiac arrest that chest compressions were administered)	• LUCAS device reduced interruptions in chest compressions and enabled defibrillation during ongoing compressions without decreasing the quality of CPR
Perkins, 2015[15]	• N = 4,471	• LUCAS-2 mechanical CPR	• Manual CPR	• 30-day survival	• No statistically significant difference in the 30-day survival rates of the 2 groups • Widespread adoption of mechanical CPR devices for routine use does not improve survival
Rubertsson, 2014[16]	• N = 2,589	• LUCAS mechanical CPR with defibrillation	• Manual CPR	• 4-hour survival • 6-month survival with good neurological outcome	• No difference in 4-hour survival for either treatment group • Mechanical CPR not clinically superior to manual CPR
Wik, 2014[17]	• N = 4,231	• Integrated automated load distributing band CPR	• High-quality manual CPR	• Survival to hospital discharge	• Integrated automated load distributing band CPR and high-quality manual CPR resulted in statistically equivalent survival to hospital discharge
Non-Randomized Studies					
Kim, 2017[18]	• N = 31	• Mechanical CPR on a reducible stretcher	• Manual CPR on a standard stretcher	• Chest compression fraction	• Chest compression fraction significantly higher in the mechanical CPR group
Venturini, 2017[19]	• N = 43	• Mechanical chest compression	• Manual chest compression	• ROSC • 30-day survival • Survival to hospital discharge	• Mechanical chest compression increased the rate of ROSC

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Wagner, 2016[20]	• N = 32	• Mechanical chest compressions	• Manual chest compressions	• Neurological outcome at hospital discharge • Survival to hospital discharge • Long term survival	• Mechanical chest compressions associated with better neurological outcome at discharge
Youngquist, 2016[21]	• N = 2,600	• Mechanical chest compressions	• Manual chest compressions	• Functional survival (cerebral performance)	• Mechanical chest compression group had a lower rate of functional survival
Koga, 2015[22]	• N = 323	• AutoPulse automated chest compression device	• Manual CPR	• Post-resuscitation injuries	• AutoPulse CPR associated with higher rates of posterior rib fracture and abdominal injury
Lin, 2015[23]	• N = 455	• Standard CPR followed by mechanical chest compression	• Standard CPR followed by manual chest compression	• ROSC • Survival to hospital admission • Medical human power demands	• No difference in early survival rates • Mechanical chest compressions promoted staff availability
Tranberg, 2015[24]	• N = 696	• LUCAS-2 mechanical chest compression device	• Manual chest compressions	• Chest compression rate • No-flow time • No-flow fraction • Fraction of time during resuscitation in which patient is without spontaneous circulation receiving no chest compression	• LUCAS-2 mechanical chest compressions reduced the no-flow fraction and provided an average compression rate more in conformity with the current Guidelines for Resuscitation
Zeiner, 2015[25]	• N = 984	• Mechanical chest compressions	• Manual chest compressions	• Neurologic outcomes • Quality of CPR	• Mechanical chest compressions associated with worse neurologic outcomes (measured in cerebral performance category)

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Smekal, 2014[26]	• N = 222	• Mechanical chest compressions (with the LUCAS device)	• Manual chest compressions	• CPR-related injuries	• Mechanical chest compressions with the LUCAS device more likely to cause rib fractures during unsuccessful CPR • No CPR-related injuries were deemed to be fatal
Axelsson, 2013[27]	• N = 2,401	• Mechanical chest compression	• Manual chest compressions	• Survival to hospital admission • 1-month survival	• The mechanical chest compression group had lower rates of survival • Results do not support widespread of mechanical chest compression
Omori, 2013[28]	• N = 92	• AutoPulse CPR	• Manual CPR	• ROSC • Survival to hospital discharge	• Rates for ROSC and survival to hospital discharge were higher in the AutoPulse group • AutoPulse device might be recommended for use in patients transported by helicopter
Hock Ong, 2012[29]	• N = 1,101	• Load-distributing band CPR	• Manual CPR	• Survival to hospital discharge • ROSC • Survival to hospital admission • Neurological outcome at discharge	• Load-distributing band CPR associated with improved neurologic outcomes and survival rate at discharge
Jennings, 2012[30]	• N = 286	• Automated CPR using the AutoPulse device	• Conventional CPR	• Survival to hospital • Survival to hospital discharge	• Automated CPR resulted in higher rate of survival to hospital

Circulation. 2016 Dec 20;134(25):2131-2133.

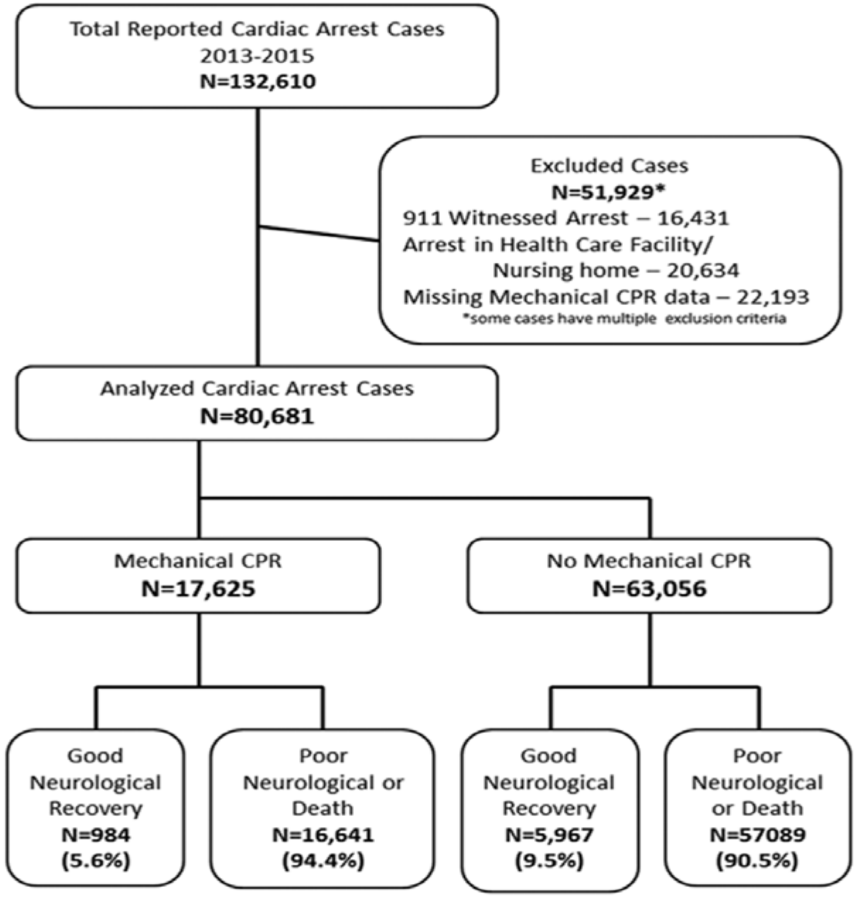
Association of Mechanical Cardiopulmonary Resuscitation Device Use With Cardiac Arrest Outcomes: A Population-Based Study Using the CARES Registry (Cardiac Arrest Registry to Enhance Survival).

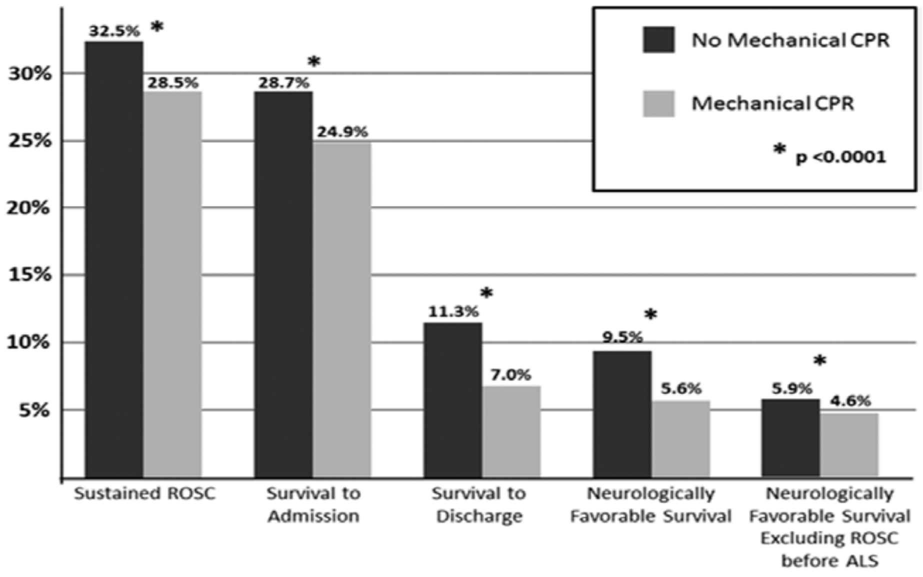
Buckler DG[1], Burke RV[1], Naim MY[1], MacPherson A[1], Bradley RN[1], Abella BS[1], Rossano JW[2]; CARES Surveillance Group.

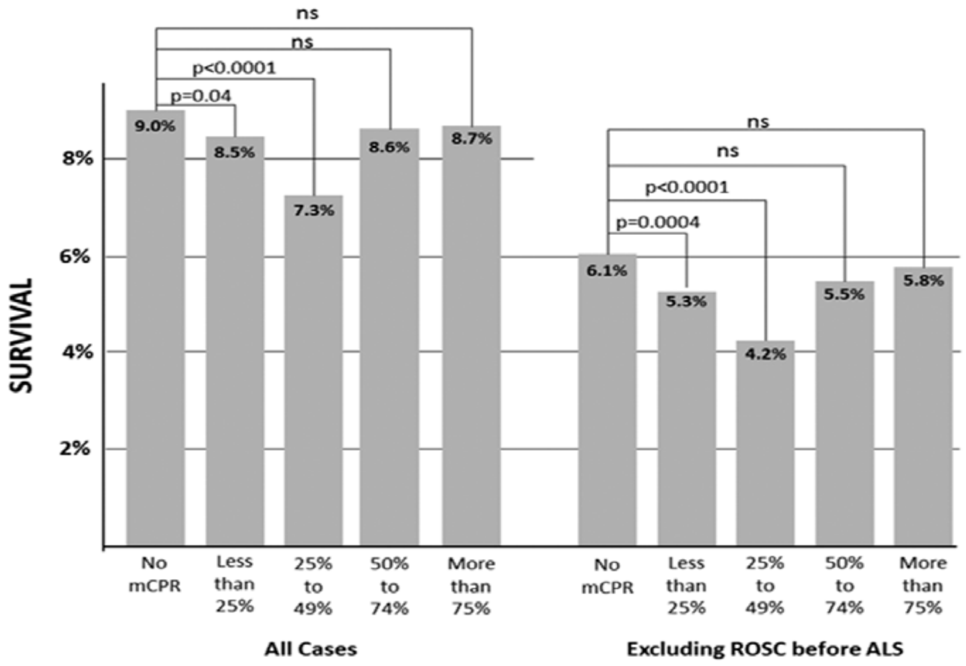
- Ocak 2013-Aralık 2015, travma dışı 80861 HDKA vakalarında , mekanik KPR ve manuel KPR karşılaştırıldı
- Mekanik KPR alan hastalar, daha yüksek oranda şahitsiz (57.3%-55.7%), OED (33.3%-28.3%), ileri hava yolu (87.4%-79.0%), and ITH kullanımı (41.8%-13.4%) ve hastane öncesi hedef sıcaklık tedavisi alanlar (16.6% - 12.2%) ($P<0.05$).
- Arrest zamanı, ilk KPR zamanı, girişimlerin zamanı iyi rapor edilmedi
- Birincil sonlanım iyi nörolojik sonuçlarla taburculuk (Serebral Performans Kategori 1 veya 2)
- 2013-2015 arasında mekanik KPR kullanımı 20.6% dan 23.4% ya yükseldi ($P<0.0001$) ve acil hizmet sağlayan kuruluşların %41.9’ u en az bir kez kullandı.
- Hastane taburculuğu (11.3% -7.0%, $P<0.0001$) ve iyi nörolojik sonuçlar ile taburculuk (9.5% - 5.6%, $P<0.0001$) manuel KPR alan grupta daha yüksek

Manuel KPR ile <%25 ve %25-50 vakada mekanik KPR kullanan kuruluşlar karşılaştırıldığında;

Yaşam ve iyi nörolojik sonuçlar ile yaşam, en yüksek oranda manuel KPR ile sağlandı


Total Reported Cardiac Arrest Cases
2013-2015
N=132,610
Excluded Cases
N=51,929*
911 Witnessed Arrest – 16,431
Arrest in Health Care Facility/
Nursing home – 20,634
Missing Mechanical CPR data – 22,193
*some cases have multiple exclusion criteria
Analyzed Cardiac Arrest Cases
N=80,681
Mechanical CPR
N=17,625
No Mechanical CPR
N=63,056
Good Neurological Recovery
N=984
(5.6%)
Poor Neurological or Death
N=16,641
(94.4%)
Good Neurological Recovery
N=5,967
(9.5%)
Poor Neurological or Death
N=57089
(90.5%)


No Mechanical CPR
Mechanical CPR
* p <0.0001
30%
25%
20%
15%
10%
5%
32.5%
28.5%
28.7%
24.9%
11.3%
7.0%
9.5%
5.6%
5.9%
4.6%
Sustained ROSC
Survival to Admission
Survival to Discharge
Neurologically Favorable Survival
Neurologically Favorable Survival Excluding ROSC before ALS


SURVIVAL
8%
6%
4%
2%
ns
ns
p<0.0001
p=0.04
9.0%
8.5%
7.3%
8.6%
8.7%
ns
ns
p<0.0001
p=0.0004
6.1%
5.3%
4.2%
5.5%
5.8%
No mCPR
Less than 25%
25% to 49%
50% to 74%
More than 75%
No mCPR
Less than 25%
25% to 49%
50% to 74%
More than 75%
All Cases
Excluding ROSC before ALS

Mekanik KPR ile daha kötü sonuçların nedenleri?

1. KPR geç başlama (cihaz uygulama süresi)
2. Defibrilasyonun gecikmesi
3. Mekanik KPR cihazlarının uygulamasındaki hatalar (insan/mekanik)
4. Zayıf prognoza sahip olabilecek uzamış KPR yapılan hastalara mekanik KPR uygulaması ?

Mekanik KPR Güvenli mi?

Mekanik KPR ile Oluşan Yaralanmalar

Journal of Forensic Radiology and Imaging 3 (2015) 167–173

Contents lists available at ScienceDirect

Journal of Forensic Radiology and Imaging

journal homepage: www.elsevier.com/locate/jofri

Forensic imaging findings by post-mortem computed tomography after manual versus mechanical chest compression

Rilana Baumeister [a,*], Ulrike Held [b], Michael J Thali [a], Patricia M Flach [a], Steffen Ross [a]

[a] University of Zurich, Institute of Forensic Medicine, Forensic Medicine and Imaging, Winterthurerstrasse 190/52, CH-8057 Zurich, Switzerland
[b] Horten Centre for Patient Oriented Research and Knowledge Transfer, University Hospital Zurich, Switzerland

Manuel KPR 20, mekanik KPR (LUCAS) 24 vaka

En sık yaralanma kaburga fraktürü

LUCAS ile vaka başına 10.38, manuel KPR ile 10.4

Subkutan pre-sternal hematom LUCAS ile daha sık

Number of injuries detected by PMCT.

Injury	Manual (20) n (%)	LUCAS (24) n (%)	p-value
Subcutaneous pre-sternal hematoma	6 (30)	15 (62.5)	0.040
Sternal fracture	12 (60)	17 (70.8)	0.532
Rib fracture	18 (90)	22 (91.7)	0.999
Rib fracture ≥ 3 right	12 (60)	16 (66.7)	0.757
Rib fracture ≥ 3 left	12 (60)	18 (75)	0.342
Location			
none	0 (0)	2 (8.3)	
Parasternal	17 (85)	21 (87.5)	
Lateral	1 (5)	0 (0)	
Posterior	0 (0)	1 (4.2)	0.886
Pneumothorax	3 (15)	7 (29)	0.450
Hemothorax	3 (15)	7 (29)	0.450
Lung contusion	7 (35)	10 (42)	0.888
Hemopericardium	0 (0*)	5 (22.7*)	0.056*
Retrosternal bleeding	9 (45)	13 (54.2)	0.763
Ruptured heart /great vessels/ dissection	4 (20)	2 (8.3)	0.387
Perihepatic bleeding	1 (5)	4 (16.7)	0.356
Perisplenic bleeding	0 (0)	5 (20.8)	0.053
Retroperitoneal bleeding	2 (10)	1 (4.2)	0.583
Pathology	19 (95)	24 (100)	0.455

* Subtraction of 3 cases in the manual group and 2 cases in the LUCAS group because hemopericardium was caused by non-CPR-related pathologies.

ESC European Society of Cardiology

European Heart Journal (2017) **38**, 3006–3013
doi:10.1093/eurheartj/ehx318

CLINICAL RESEARCH
Arrhythmia/electrophysiology

Safety of mechanical chest compression devices AutoPulse and LUCAS in cardiac arrest: a randomized clinical trial for non-inferiority

Rudolph W. Koster[1]*, Ludo F. Beenen[2], Esther B. van der Boom[1], Anje M. Spijkerboer[2], Robert Tepaske[3], Allart C. van der Wal[4], Stefanie G. Beesems[1], and Jan G. Tijssen[1]

[1]Department of Cardiology, Academic Medical Center, Room G4-230, Meibergdreef 9, 1105 AZ, Amsterdam, The Netherlands; [2]Department of Radiology, Academic Medical Center, Meibergdreef 9, 1105 AZ, Amsterdam, the Netherlands; [3]Department of Intensive Care, Academic Medical Center, Meibergdreef 9, 1105 AZ, Amsterdam, the Netherlands; and [4]Department of Pathology, Academic Medical Center, Meibergdreef 9, 1105 AZ, Amsterdam, the Netherlands

Received 7 December 2016; revised 13 March 2017; editorial decision 12 May 2017; accepted 24 May 2017; online publish-ahead-of-print 1 July 2017

See page 3014 for the editorial comment on this article (doi: 10.1093/eurheartj/ehx500)

Aims Mechanical chest compression (CC) during cardiopulmonary resuscitation (CPR) with AutoPulse or LUCAS devices has not improved survival from cardiac arrest. Cohort studies suggest risk of excess damage. We studied safety of mechanical CC and determined possible excess damage compared with manual CC.

Methods and results This is a randomized non-inferiority safety study. Randomization to AutoPulse, LUCAS, or manual CC with corrective depth and rate feedback was performed. We included patients with in-hospital cardiac arrest or with out-of-hospital cardiac arrest arriving with manual CPR at the emergency department. The primary outcome was serious or life-threatening visceral resuscitation-related damage, assessed blind by post-mortem computed tomography scan and/or autopsy or by clinical course until discharge. Non-inferiority hypothesis: mechanical CC compared with manual control does not increase the primary outcome by a risk difference of > 10% [upper 95% confidence interval (CI)]. We included 115 patients treated with AutoPulse, 122 with LUCAS, and 137 patients received manual CC. Safety outcome analysis was possible in 337 of 374 (90.1%) included patients. The primary outcome was observed in 12 of 103 AutoPulse patients (11.6%), 8 of 108 LUCAS patients (7.4%), and 8 of 126 controls (6.4%). Rate difference AutoPulse—control: +5.3% (95% CI - 2.2% to 12.8%), $P = 0.15$. Rate difference LUCAS—control +1.0% (95% CI - 5.5% to 7.6%), $P = 0.75$.

Conclusion LUCAS does not cause significantly more serious or life-threatening visceral damage than manual CC. For AutoPulse, significantly more serious or life-threatening visceral damage than manual CC cannot be excluded.

Keywords Chest compressions • Heart arrest • Mechanical chest compressions • Cardiopulmonary resuscitation • Damage • Safety

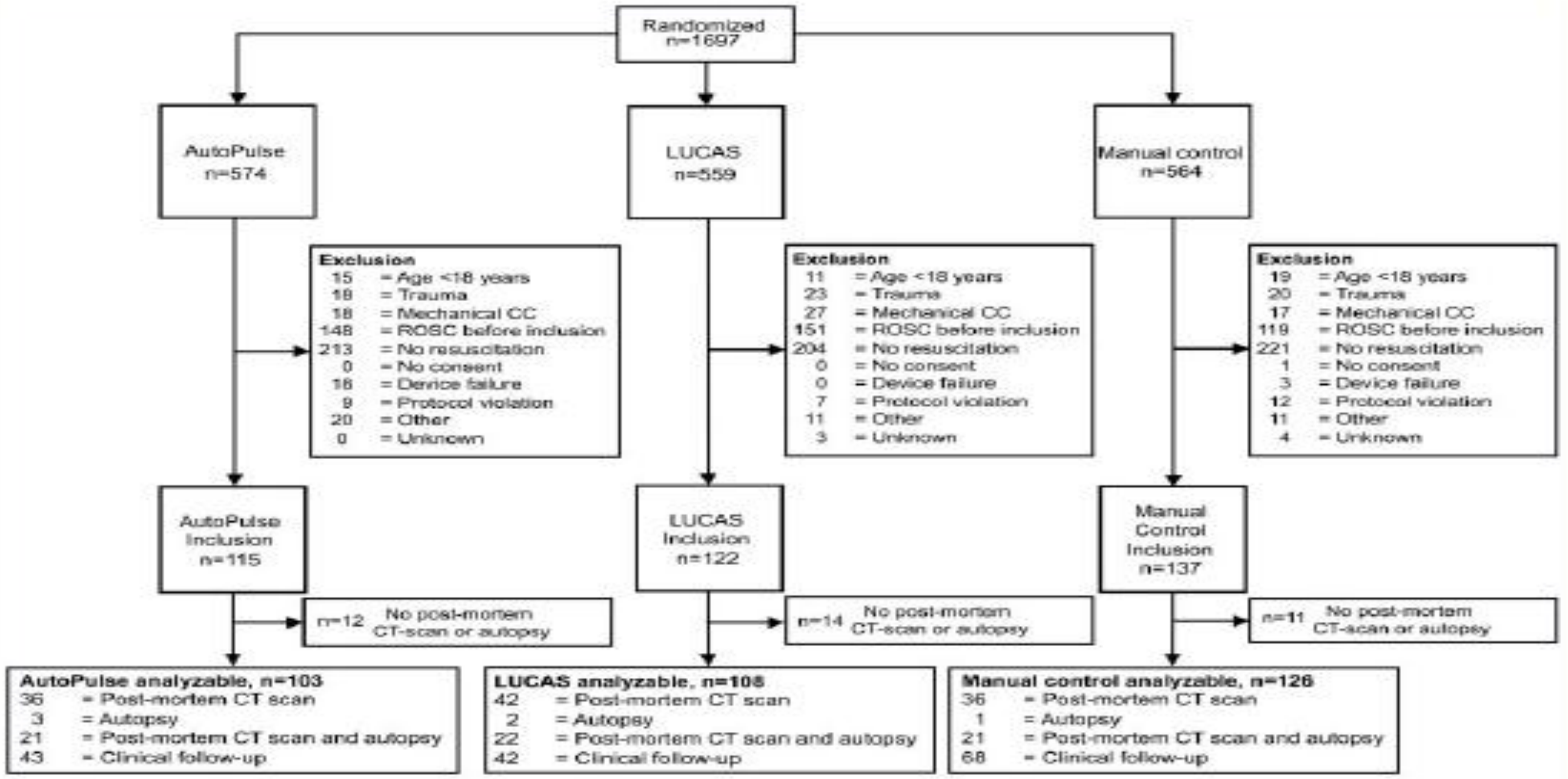


Figure 1 Flowchart displaying randomization, exclusion, and inclusion. CC, chest compression; ROSC, return of spontaneous circulation; CT, computed tomography.

Table 1 **Baseline and process data**

	AutoPulse ($n = 115$)	LUCAS ($n = 122$)	Manual control ($n = 137$)
Gender male, *n* (%)	75 (65.2)	82 (67.2)	87 (63.5)
Age (years, mean ± SD)	65 ± 15	63 ± 17	66 ± 13
Location of arrest onset			
Out-of-hospital, *n* (%)	53 (46.1)	53 (43.4)	50 (36.5)
In-hospital, *n* (%)	62 (53.9)	69 (56.6)	87 (63,5)
Interval call-start study device (min, median, IQR)[a]			
Out-of-hospital	60 (56–71)	57 (48–62)	57 (43–67)
In-hospital	10 (5–20)	8 (4–11)	5 (3–8)
Duration of connection study device (min, median, IQR)	21 (10–31)	22 (7–39)	16 (6–32)
Compression depth (mm, mean ± SD)			48 ± 9
Compression rate (per minute, mean ± SD)			110 ± 14

[a]For out-of-hospital cardiac arrest, the call was the call to the dispatch centre; for in-hospital cardiac arrest, it was the call to the hospital central switchboard.

Table 2 **Primary and secondary outcomes in analysable patients**

	AutoPulse (*N* = 103)	LUCAS (*N* = 108)	Manual control (*N* = 126)	Rate difference AutoPulse vs. control (%) (95% CI)[a]	Rate Difference LUCAS vs. Control (%) (95% CI)[a]
Resuscitation-related structural visceral damage (primary endpoint)					
Serious or life-threatening damage, overall, *n* (%)	12 (11.7)	8 (7.4)	8 (6.3)	5.3 (-2.2 to 12.8)	1.0 (-5.5 to 7.6)
Out-of-hospital arrest onset, *n*/*N* (%)	6/44 (13.6)	3/46 (6.5)	2/48 (4.2)	9.4 (-2.1 to 21.1)	2.4 (-6.7 to 11.5)
In-hospital arrest onset, *n*/*N* (%)	6/59 (10.2)	5/62 (8.1)	6/78 (7.7)	2.5 (-7.2 to 12.2)	-0.23 (-8.9 to 8.4)
Insignificant damage, *n* (%)	6 (5.8)	11 (10.2)	13 (10.3)		
No damage, *n* (%)	85 (82.5)	89 (82.4)	105 (83.3)		
Serious or life-threatening resuscitation-related visceral damage—details[b]					
Pneumothorax, *n*	6	2	4		
Tension pneumothorax, *n*	1	1	—		
Pneumomediastinum/oesophagus haematoma, *n*	4	—	—		
Pleural fluid/blood, *n*	1	3	3		
Lung contusion/haematoma, *n*	1	—	1		
Liver rupture, *n*	1	2	—		
Intracranial air embolism, *n*	1	—	—		
Pneumoperitoneum, n	—	1	—		
Resuscitation-related rib and sternum damage (secondary endpoint)					
Serious, *n* (%)	47 (45.6)	43 (39.8)	52 (41.3)	4.4 (-8.5 to 17.3)	-1.5 (-14.1 to 11.2)
Insignificant damage, *n* (%)	10 (9.7)	9 (8.3)	22 (17.5)		
No damage, *n* (%)	46 (44.7)	56 (51.9)	52 (41.3)		
Mean number of fractured ribs, mean ± SD[c]	8 ± 4	8 ± 4	7 ± 4	n.s.	n.s.
Sternum fractures, *n* (%)	3 (2.9)	7 (6.5)	5 (4.0)	-1.2 (-6.8 to 4.6)	2.3 (-3.8 to 9.1)

[a]95% confidence interval according to Miettinen.[14]
[b]Some patients had more than one kind of serious or life-threatening visceral damage.
[c]Calculated for the patients with rib fractures.

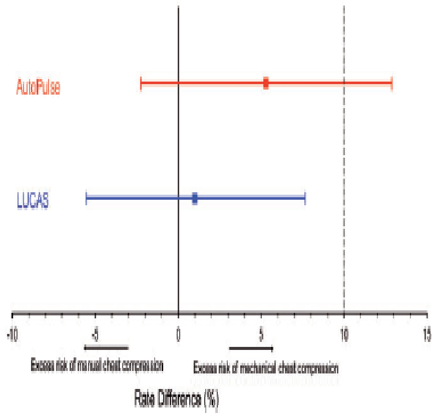


Figure 2 Rate differences of resuscitation-related serious or life-threatening damage between mechanical chest compressions and manual chest compressions. The dotted line at + 10% indicates the boundary of excess risk difference that should not be exceeded to accept the non-inferiority hypothesis.

Conclusions

The use of mechanical chest compressions with the LUCAS device does not cause more severe or life-threatening visceral damage than good quality manual chest compressions. For mechanical chest compressions with the AutoPulse, it cannot be excluded that more severe or life-threatening damage is caused, compared with good quality manual chest compressions.

Ne zaman mekanik KPR?


ABC

Contents lists available at ScienceDirect
Resuscitation
journal homepage: www.elsevier.com/locate/resuscitation
ELSEVIER
EUROPEAN RESUSCITATION COUNCIL

Clinical paper

Mechanical chest compressions improve rate of return of spontaneous circulation and allow for initiation of percutaneous circulatory support during cardiac arrest in the cardiac catheterization laboratory

Joseph M. Venturini[a], Elizabeth Retzer[b], J. Raider Estrada[c], Janet Friant[a], David Beiser[d], Dana Edelson[e], Jonathan Paul[a], John Blair[a], Sandeep Nathan[a], Atman P. Shah[a,*]

[a] Section of Cardiology, Department of Medicine, University of Chicago Medical Center, 5841 S. Maryland Ave, Chicago, IL 60637, USA
[b] Centegra Health System, 360 North Terra Cotta, Crystal Lake, IL 60012, USA
[c] MaineHealth Cardiology, Maine Medical Partners, 96 Campus Drive, Scarborough, ME 04074, USA
[d] Section of Emergency Medicine, Department of Medicine, University of Chicago Medical Center, 5841 S. Maryland Ave, Chicago, IL 60637, USA
[e] Department of Medicine, University of Chicago Medical Center, 5841 S. Maryland Ave, Chicago, IL 60637, USA

ARTICLE INFO

Article history:
Received 24 January 2017
Received in revised form 27 March 2017
Accepted 30 March 2017

ABSTRACT

Background: Performing advanced cardiac life support (ACLS) in the cardiac catheterization laboratory (CCL) is challenging. Mechanical chest compression (MCC) devices deliver compressions in a small space, allowing for simultaneous percutaneous coronary intervention and reduced radiation exposure to rescuers. In refractory cases, MCC devices allow rescuers to initiate percutaneous mechanical circulatory

Mechanical cardiopump use in organ donation after prehospital cardiac death

Alonso A. Mateos Rodríguez[1], José María Navalpotro Pascual[1], María Eugenia Martín Maldonado[2], Calos Barba Alonso[2], Luis Pardillos Ferrer[1], Amado Andrés Belmonte[3]

[1]Comisión de Investigación SUMMA112. [2]Médico SUMMA112. [3]Coordinador de Trasplantes, Hospital 12 de Octubre. Madrid, Spain.

Resuscitation 81 (2010) 383–387

Contents lists available at ScienceDirect
Resuscitation
journal homepage: www.elsevier.com/locate/resuscitation
ELSEVIER
RESUSCITATION

Clinical paper

Cardiac arrest in the catheterisation laboratory: A 5-year experience of using mechanical chest compressions to facilitate PCI during prolonged resuscitation efforts☆

Henrik Wagner[a], Christian J. Terkelsen[b], Hans Friberg[c], Jan Harnek[a], Karl Kern[d], Jens Flensted Lassen[b], Goran K. Olivecrona[a,*]

Resuscitation (2007) 75, 454–459
ELSEVIER
RESUSCITATION
www.elsevier.com/locate/resuscitation

CLINICAL PAPER

Cardiac arrest with continuous mechanical chest compression during percutaneous coronary intervention
A report on the use of the LUCAS device☆

Alf Inge Larsen[a,b,*], Åshild S. Hjørnevik[a], Christian Lycke Ellingsen[c], Dennis W.T. Nilsen[a,b]

Resuscitation 86 (2015) 88–94

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

ELSEVIER

Clinical Paper

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)☆

Dion Stub[c,f,g], Stephen Bernard[a,b,d,*], Vincent Pellegrino[a], Karen Smith[b,d,e], Tony Walker[d], Jayne Sheldrake[a], Lisen Hockings[a], James Shaw[a,b,c], Stephen J. Duffy[a,b,c], Aidan Burrell[a,b], Peter Cameron[a,b], De Villiers Smit[a], David M. Kaye[a,b,c]

- Prospektif, gözlemsel, tek merkezde, 11 HDKA, 15 HİKA, ort yaş 52 (38-60)
- Çalışmaya dahil edilen hastalar:

  -18-65 yaş

  -Kardiak etiyolojiden şüphelenilen kardiyak arrest

  -10 dakika içinde göğüs kompresyonu başlatılanlar

  -İlk kardiyak arrest ritmi VF olan hastalar
- 30 dk dirençli kardiyak arrest olan hastalar AutoPulse ile mekanik KPR, hastane nakli sırasında 2 L soğuk salin, standart ALS desteği
- Kollaps ile hastaneye varış süresi arasındaki zaman ort 62 dk (yaşayanlarda 42, ölenlerde 70 dk)
- ECMO (vakaların %92'sinde kollapstan sonra ECMO başlatılma zamanı 52 dk)

- 11 hastada perkütan koroner girişim, 1 hastada pulmoner embolektomi
- Yoğun bakımda 24 saat 33˚C de hipotermi
- ECMO zamanı ort 2 gün (1-5)
- 25/26 (%92) vaka ROSC
- 13/24 (%54) vaka başarılı şekilde ECMO dan ayrıldı
- 14/26 (%54) vaka hastaneden SPS 1 ile taburcu (5 HDKA, 9 HİKA)
- Yaşayan ve ölen hastalar arasında ECMO başlama zamanı arasında fark 40 dk
- Ölüm nedenleri: şiddetli hipoksik beyin (4), çoklu organ yetmezliği (3), serebral kanama (2), karaciğer rüptürüne bağlı kanama (1), kaburga fraktürüne bağlı toraks kanaması (1), koroner arter hastalığa bağlı kronik kalp yetmezliği (1)

Kesintisiz KPR
Tutarlı hız ve derinlik
Daha az personel ile KPR
Daha iyi serebral, koroner perfüzyon basıncı
Kurtarıcı yorgunluğu yok

FAYDA

Yaşam tehdit edici yaralanmalar
Eğitimli personel
Uygula sırasında zaman kaybı
Maliyet
Defibrilasyonda gecikme

RİSK

mKPR

ÖZET

- Manuel KPR yerine mekanik KPR rutin olarak önerilmez
- Yüksek kalitede göğüs kompresyonları yapılamıyor ya da kurtarıcı için tehlike mevcut ise;

  -Uzamış KPR

  -Ambulans ile hastaneye nakil

  -ECMO

  -Perkütan koroner girişim

  -Transplantasyon adayı vakalar
- Kullanıcı eğitimi önemli
- Mekanik KPR cihazı uygulaması sırasında, göğüs kompresyonlarındaki kesinti minimal olmalı, defibrilasyon geciktirilmemeli
- Manuel veya mekanik KPR yapılırken, KPR ile ilgili yaralanmalar için dikkatli olunmalı