Mechanical CPR

Summary of Comparative Human Findings

Note to the Reader

This booklet is a compilation of abstracts from the scientific literature that examine the effectiveness of various mechanical CPR technologies in comparison to manually delivered chest compressions. Collectively, these abstracts summarize data regarding the efficacy of these systems based on a number of factors. Findings are reported for various vital signs, blood flow, return of spontaneous circulation, and both short- and long-term survival.

In the 10-plus years since the current generation of commercially available systems has come to market, the science has advanced to a point where the focus should be on statistically tested findings derived from human trials that compare a technology to manually performed chest compressions. Accordingly animal experiments, case studies, case series, and mannequin studies are excluded. It is the hope that this summary will stir your interest to examine the original publications.

The impact of CPR duration on survival to hospital discharge between integrated AutoPulse-CPR and manual-CPR during out-of-hospital cardiac arrest of presumed cardiac origin

Wik L, et al. *Resuscitation*. 2012;83:e17

Background:

The Circulation Improving Resuscitation Care (CIRC) Trial found equivalent survival in out-of-hospital cardiac arrest (OHCA) patients who received integrated AutoPulse CPR (iA-CPR) compared to high quality Manual CPR (M-CPR). We hypothesized that as prehospital CPR time increased iA-CPR would provide a survival benefit when compared to high quality M-CPR.

Methods:

A subgroup-analysis of the CIRC randomized clinical trial was conducted. Patients were included in the CIRC trial if they had an OHCA treated by a participating emergency medical service (EMS) in one of five study communities. Randomization occurred after manual compressions were initiated. Only those patients whose OHCA was EMS or bystander witnessed and had a shockable initial rhythm were included in this analysis. Duration of CPR was obtained from data recorded by the EMS defibrillator, and defined as the interval between the time the defibrillator was turned on and the time resuscitation was terminated or the time of the first documented return of spontaneous circulation. Logistic Regression was used to model the interaction between treatment and length of resuscitation and was covariate-adjusted for trial site and patient age. The primary outcome was survival to hospital discharge.

Results:

4,231 subjects were enrolled in the CIRC trial. 674 patients had witnessed shockable arrests. Of those, 621 had complete outcome and duration of CPR data (294 iA-CPR, 327 M-CPR). The logistic model had an overall p-value <0.0001 and a Hosmer-Lemeshow goodness-of-fit p-value of 0.20. The covariate-adjusted odds-ratio for survival to hospital discharge in the iA-CPR arm was1.49 compared to M-CPR with a p-value = 0.037 and a 95% CI of 1.02 to 2.16. The odds-ratio for survival to hospital discharge in favor of iA-CPR compared to M-CPR increased as the duration of resuscitation increased. iA-CPR had a survival benefit compared to M-CPR when the resuscitation duration was greater than 10 minutes.

Conclusion:

Compared to high quality M-CPR, iA-CPR resulted in a statistically significant improvement in survival to hospital discharge for adult witnessed shockable OHCA patients with a longer duration of CPR.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 621)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☑	☐
$EtCO_2$	☐	☐

Comparison of load-distributing band and standard cardiopulmonary resuscitation in patients presenting with cardiac arrest to the emergency department

Ong M, et al. *Prehospital Emergency Care.* 2011;15:106.

Objective:

To compare resuscitation outcomes before and after switching from manual cardiopulmonary resuscitation (CPR) to load distributing-band (LDB) CPR in a multicenter emergency department (ED) trial.

Methods:

This was a phased, prospective cohort evaluation with intention-to-treat analysis of adults with nontraumatic cardiac arrest. The intervention was change in the system from manual CPR to LDB-CPR at two urban EDs. The main outcome measure was survival to hospital discharge, with secondary outcome measures of return of spontaneous circulation (ROSC), survival to hospital admission, and neurologic outcome at discharge.

Results:

A total of 1,011 patients were included in the study, with 459 in the manual CPR phase (January 1, 2004, to August 24, 2007) and 552 patients in the LDB-CPR phase (August 16, 2007, to December 31, 2009). In the LDB-CPR phase, the LDB device was applied in 454 patients (82.3%). The patients in the manual CPR and LDB-CPR phases were comparable for mean age, gender, and ethnicity. Rates for ROSC were comparable with LDB-CPR (manual CPR 22.4% vs. LDB-CPR 35.3%; adjusted odds ratio [OR], 1.07; 95% confidence interval [CI],0.63-1.83). Survival to hospital admission was increased (manual CPR 14.2% vs. LDB-CPR 19.7%; adjusted OR, 2.50; 95% CI, 1.05-6.00). Survival to hospital discharge was increased (manual CPR 1.3% vs. LDB-CPR 3.3%; adjusted OR, 3.99; 95% CI, 1.06-15.02). The number of survivors with Cerebral Performance Category 1 (good) (manual CPR 1 vs. LOB-CPR 12, $p < 0.01$) and Overall Performance Category 1 (good) (manual CPR 1 vs. LDB-CPR 10, $p < 0.01$) was also increased. The number needed to treat (NNT) for 1 survivor was 52 (95% CI, 26-1,000).

Conclusion:

A resuscitation strategy using LDB-CPR in an ED environment was associated with improved survival to admission and discharge in adults with nontraumatic cardiac arrest.

Conclusion:

Compared with resuscitation using manual CPR, a resuscitation strategy using LDB-CPR on EMS ambulances is associated with improved survival to hospital discharge in adults with out-of-hospital nontraumatic cardiac arrest.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 1,011)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Purfusion Pressure	☐	☐
ROSC	☐	☑
CPR Fraction	☐	☐
Survival (Admission)	☑	☐
Survival (Discharge)	☑	☐
$EtCO_2$	☐	☐

Use of an automated, load-distributing band chest compression device for out-of-hospital cardiac arrest resuscitation

Ong ME, Ornato JP, Edwards DP. *JAMA*. 2006;295:2629-37.

Aim:

Only 1% to 8% of adults with out-of-hospital cardiac arrest survive to hospital discharge.

Objective:

To compare resuscitation outcomes before and after an urban emergency medical services (EMS) system switched from manual cardiopulmonary resuscitation (CPR) to load-distributing band (LDB) CPR.

Design, Setting, and Patients:

A phased, observational cohort evaluation with intention-to-treat analysis of 783 adults with out-of-hospital, nontraumatic cardiac arrest. A total of 499 patients were included in the manual CPR phase (January 1, 2001, to March 31, 2003) and 284 patients in the LDB-CPR phase (December 20, 2003, to March 31, 2005); of these patients, the LDB device was applied in 210 patients.

Intervention:

Urban EMS system change from manual CPR to LDB-CPR.

Main Outcome Measures:

Return of spontaneous circulation (ROSC), with secondary outcome measures of survival to hospital admission and hospital discharge, and neurological outcome at discharge.

Results:

Patients in the manual CPR and LDB-CPR phases were comparable except for a faster response time interval (mean difference, 26 seconds) and more EMS-witnessed arrests (18.7% vs 12.6%) with LDB. Rates for ROSC and survival were increased with LDB-CPR compared with manual CPR (for ROSC, 34.5%; 95% confidence interval [CI], 29.2%-40.3% vs 20.2%; 95% CI, 16.9%-24.0%; adjusted odds ratio [OR], 1.94; 95% CI, 1.38-2.72; for survival to hospital admission, 20.9%; 95%CI, 16.6%-26.1% vs 11.1% 95% CI, 8.6%-14.2%; adjusted OR, 1.88; 95% CI, 1.23-2.86; and for survival to hospital discharge, 9.7%; 95% CI, 6.7%-13.8% vs 2.9%; 95% CI, 1.7%-4.8%; adjusted OR, 2.27; 95% CI, 1.11-4.77). In secondary analysis of the 210 patients in whom the LDB device was applied, 38 patients (18.1%) survived to hospital admission (95% CI, 13.4%-23.9%) and 12 patients (5.7%) survived to hospital discharge (95% CI, 3.0%-9.3%). Among patients in the manual CPR and LDB-CPR groups who survived to hospital discharge, there was no significant difference between groups in Cerebral Performance Category (P=.36) or Overall Performance Category (P=.40). The number needed to treat for the adjusted outcome survival to discharge was 15 (95% CI, 9-33).

Conclusion:

Compared with resuscitation using manual CPR, a resuscitation strategy using LDB-CPR on EMS ambulances is associated with improved survival to hospital discharge in adults with out-of-hospital nontraumatic cardiac arrest.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 783)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Purfusion Pressure	☐	☐
ROSC	☑	☐
CPR Fraction	☐	☐
Survival (Admission)	☑	☐
Survival (Discharge)	☑	☐
$EtCO_2$	☐	☐

Improvement in field return of spontaneous circulation using circumferential chest compression cardiopulmonary resuscitation

Ornato JP, Peberdy MA, Edwards DP, et al. Richmond Ambulance Authority, Richmond, Virginia.
Prehospital Energency Care. 2005;9:104

Aim:

There is evidence that circumferential chest compression (CCC) can improve arterial perfusion pressure compared to that which can be achieved with standard (STD) cardiopulmonary resuscitation (CPR) in animal models and critically ill patients undergoing CPR in the intensive care unit. It is unknown whether this hemodynamic difference will result in any improvement in the rate of return of spontaneous circulation (ROSC) from out-of-hospital cardiac arrest.

Objective:

To compare the rates of ROSC before and after an all–advanced life support (all-ALS) urban emergency medical services system converted from using STD-CPR to CCC-CPR as standard of care.

Methods:

CCC-CPR was performed using AutoPulse devices (Revivant Corp., Sunnyvale, CA) which were placed into service on all ALS ambulances in Richmond, VA, on December 20, 2003. The percentages ROSC from all adult, out-of-hospital, non-traumatic cardiac arrest cases of presumed cardiac origin were compared from 5 years before, and for the first 6 months following, conversion from STD-CPR to CCC-CPR in the Richmond Ambulance Authority. No other significant operational or medical protocol changes were made in the EMS system during the changeover period.

Results:

ROSC for all patients rose dramatically from 21.6 ± 3.1% (95% CI 17.7–25.4%) to 37.5% from the STD-CPR (n = 1,007) to CCC-CPR (n = 79) periods, representing a 74% relative increase in ROSC. The improvement occurred regardless of the patient's initial cardiac arrest rhythm: ventricular fibrillation or ventricular tachycardia [25.2 ± 4.1% (95% CI 20.1–30.3%) STD-CPR (n = 239) to 47.4% with CCC-CPR (n = 19)]; asystole [12.3 ± 4.7% (95% CI 6.5–18.1%) STD-CPR (n = 536) to 29.3% with CCC-CPR (n = 41)]; and pulseless electrical activity [33.2 ±10.1% (95% CI 20.5–45.8%) STD-CPR (n = 232) to 47.4% with CCC-CPR (n = 19)].

Conclusion:

In this preliminary before-and-after case series comparison, the use of CCC-CPR resulted in a significant improvement in field ROSC that occurred independent of the initial presenting rhythm. This hypothesis-generating observation strongly supports the need for an adequately powered, prospective randomized clinical trial comparing the two CPR techniques.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 1,007)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Purfusion Pressure	☐	☐
ROSC	☑	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

The analysis of efficacy for AutoPulse™ system in a flying helicopter

Omoria K, Satob S, Sumic Y, et al. 2013 Jan 23. Pii: S0300-9572(13)00045-2. doi:10.1016/j. Resuscitation. 2013.01.014. [Epub ahead of print]

Aim:

The helicopter emergency medical services (HEMS) was introduced in Japan in 2001, and some cardiopulmonary arrest (CPA) patients are transported using this service. However, it is difficult to maintain continuous and effective manual cardiopulmonary resuscitation (CPR) in flying helicopters. To overcome this problem, the AutoPulse system, automated mechanical CPR devices, was introduced. We conducted a retrospective study to clarify the efficacy of AutoPulse on CPA patients in flying helicopters.

Methods:

In total, 92 CPA patients were enrolled in this study. Of these, 43 CPA patients received manual CPR (between April 2004 and June 2008), and 49 patients received AutoPulse CPR (between July 2008 and March 2011). We compared the manual CPR group with the AutoPulse group using logistic regression analysis and examined the efficacy of AutoPulse in flying helicopters.

Results:

Rates for return of spontaneous circulation (ROSC) and survival to hospital discharge were increased in the AutoPulse group compared to the manual CPR group (ROSC, 30.6% [15 patients] vs. 7.0% [3 patients]; survival to hospital discharge, 6.1% [3 patients] vs. 2.3% [1 patient]). In multivariate analysis, the factors associated with ROSC were the use of AutoPulse (odds ratio [OR], 7.22; P=0.005) and patients aged ≤65 years (OR, 0.31; P= 0.042).

Conclusions:

The present study demonstrates that the use of AutoPulse in flying helicopters was significantly effective for the ROSC in CPA patients. The use of automated chest compression devices such as AutoPulse might be recommended at least for CPA patients transported by helicopters.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☑	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

Improved hemodynamic performance with a novel chest compression device during treatment of in-hospital cardiac arrest

Timerman S, Cardoso LF, Ramires JA, et al. *Resuscitation*. 2004;61:273-80.

Introduction:

The purpose of this pilot clinical study was to determine if a novel chest compression device would improve hemodynamics when compared to manual chest compression during cardiopulmonary resuscitation (CPR) in humans. The device is an automated self-adjusting electromechanical chest compressor based on AutoPulse™ technology (Revivant Corporation) that uses a load distributing compression band (A-CPR) to compress the anterior chest.

Methods:

A total of 31 sequential subjects with in-hospital sudden cardiac arrest were screened with institutional review board approval. All subjects had received prior treatment for cardiac disease and most had co-morbidities. Subjects were included following 10 min of failed standard advanced life support (ALS) protocol. Fluid-filled catheters were advanced into the thoracic aorta and the right atrium and placement was confirmed by pressure waveforms and chest radiograph. The coronary perfusion pressure (CPP) was measured as the difference between the aortic and right atrial pressure during the chest compression's decompressed state. Following 10 min of failed ALS and catheter placement, subjects received alternating manual and A-CPR chest compressions for 90 s each. Chest compressions were administered without ventilation pauses at 100 compressions/min for manual CPR and 60 compressions/min for A-CPR. All subjects were intubated and ventilated by bag-valve at 12 breaths/min between compressions. Epinephrine (adrenaline) (1 mg i.v. bolus) was given at the request of the attending physician at 3–5 min intervals.

Results:

Usable pressure signals were present in 16 patients (68 ± 6 years, 5 female), and data are reported from those patients only. A-CPR chest compressions increased peak aortic pressure when compared to manual chest compression (153 ± 28mmHg versus 115 ± 42 mmHg, $P < 0.0001$, mean ± S.D.). Similarly, A-CPR increased peak right atrial pressure when compared to manual chest compression (129 ± 32mmHg versus 83 ± 40 mmHg, $P < 0.0001$). Furthermore, A-CPR increased CPP over manual chest compression (20 ± 12mmHg versus 15 ± 11 mmHg, $P < 0.015$). Manual chest compressions were of consistent high quality (51 ± 20 kg) and in all cases met or exceeded American Heart Association guidelines for depth of compression.

Conclusion:

Previous research has shown that increased CPP is correlated to increased coronary blood flow and increased rates of restored native circulation from sudden cardiac arrest. The A-CPR system using AutoPulse technology demonstrated increased coronary perfusion pressure over manual chest compression during CPR in this terminally ill patient population.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 31)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☑	☐
Coronary Perfusion Pressure	☑	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

AutoPulse mechanical chest compressions improve $ETCO_2$ in victims of out-hospital cardiac arrest

Swanson M, Poniatowski M, O'Keefe M. *Circulation*. 2008;118:S 767.

End tidal carbon dioxide ($ETCO_2$) is related to cardiac output, and thus chest compression (CC) quality, during cardiopulmonary resuscitation. This study was conducted to compare $ETCO_2$ during AutoPulse mechanical CC (A-CC) and manual CC (M-CC) in victims of out-hospital cardiac arrest (OHCA). Three hundred twenty-five consecutive OHCA patients treated by EVAC Ambulance (Volusia County, Florida) between October 2003 and April 2006 who received either A-CC (N=125) or M-CC (N=200) and routine capnographic monitoring following endotracheal intubation were enrolled in this retrospective study. $ETCO_2$ was sequentially measured at 4 separate times (T1:8.0 ± 6.3, T2:12.9 ± 5.5, T3:15.9 ± 5.8, and T4:18.8 ± 6.3 min from time of patient contact). $ETCO_2$ measurements occurring after return of spontaneous circulation (ROSC) were excluded. Patient characteristics were similar in patients treated with A-CC and M-CC. $ETCO_2$ was similar at T1 in patients treated with A-CC and M-CC but greater at later time points with A-CC. The difference in $ETCO_2$ measured at T1 and T2 ($dETCO_2$=$ETCO_2$ at T2-$ETCO_2$ at T1) was significantly higher for A-CC compared with M-CC (2.0 vs. –0.8, p=0.01). Mean, minimum and maximum values of $ETCO_2$ measured during the range of T1 to T4 were also higher for A-CC than M-CC (16 vs. 13.8, p=0.008; 12.8 vs. 10.9, p=0.02; 19.3 vs. 16.9, p=0.02, respectively). Both mean ETCO2 and $dETCO_2$ had predictive value for ROSC-ED (emergency department) in patients treated with A-CC. $ETCO_2$ tends to rise during A-CC and fall during M-CC in OHCA patients. Early rise in $ETCO_2$ may predict a favorable outcome during A-CC.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 325)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☑	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☑	☐

A CPR assist device increased emergency department admission and end tidal carbon dioxide partial pressures during treatment of out of hospital cardiac arrest

Swanson M, Poniatowski M, O'Keefe M, Springer P. *Circulation*. 2006;114:II-554.

Objective:

EVAC Ambulance, serving Volusia County, Florida (1,207 square miles, population468,000), used a load-distributing-band chest compression device (AutoPulse, ZOLL Circulation, ACPR) and evaluated its impact on end tidal carbon dioxide (ETCO2) and patient survival to emergency department admission during out-of-hospital cardiac arrest. An intention to treat, concurrentlycontrolled, retrospective review was undertaken to compare A-CPR to manual cardiopulmonary resuscitation (M-CPR).

Methods:

A-CPR (n=269) was used by advanced life support certified paramedics until return of spontaneous circulation or until death was declared. Patient survival to emergency department admission with measurable blood pressure (short-term survival) was evaluated. All data were compiled from dispatch, patient care, and monitor/defibrillator records. The M-CPR comparison group (n=607) received the same treatment but without A-CPR. During the study period, cardiac arrest treatment protocols followed AHA Guidelines 2000. Routine capnographic monitoring yielded sequential ETCO2 values recorded following endotracheal intubation. Ventilation was achieved using a transport ventilator with fixed minute ventilation.

Results:

There were no differences between groups in patient characteristics or other factors typically associated with cardiac arrest survival. A-CPR increased short-term survival overall (M-CPR 18%, A-CPR 28%, OR 1.7, 95% CI 1.2–2.4, p=0.001). ETCO2 at four sequential time points following intubation was evaluated (M-CPR: 18±1, 18±1, 18±1, 18±2 mmHg; A-CPR: 23±1 23±1 24±2 27±3 mmHg; mean±SE, p<0.01 each M vs. A-CPR). Multifactor logistic regression showed sequential ETCO2 increases temporally with A-CPR (p<0.005) but not with M-CPR. The model showed shortterm survival was correlated with ETCO2 levels in both arms, however there was a significant interaction between A-CPR and ETCO2 but not with M-CPR (p<0.01).

Conclusion:

This study was limited by a lack of data on long-term survival and non-randomized design. Despite these limitations, treatment with AutoPulse CPR showed a significant increase in short-term survival and ETCO2 was higher at every time point compared to manual CPR.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 623)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☑	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☑	☐

The effect of the external chest compression appliance (AutoPulse™) on cardiac arrest in the emergency department and influence on blood gas and N-terminal B-type natriuretic peptide

Liu Q, Li CS. *Chinese Critical Care Medicine.* 2010;22:660-62.

Aim:

To investigate the value of AutoPulse in the patients with cardiac arrest (CA) in emergency department.

Methods:

Patients with CA seen in the Emergency Department of Chaoyang Hospital, Affiliated to Capital Medical University from September 2008 to August 2009 were divided into standard manual external chest compression group (n=42) and mechanical chest compression group with AutoPulse (n=43), based on the method of the external chest compression. Tracheal intubation was performed and mechanical ventilation instituted in all the patients. Other rescue measures, such as intravenous infusion of fluids, electrocardiogram, electric shock for defibrillation were performed following the cardiopulmonary guideline of 2005. The patients with restoration of spontaneous circulation in 20 minutes were excluded. Among patients with resuscitation over 20 minutes, there were 29 cases in AutoPulse group and 28 cases in standard manual external chest compression group. The blood gas and N-terminal B-type natriuretic peptide (NT-proBNP) from the blood samples obtained from the femoral artery 20 minutes after resuscitation were determined, and the survival rate at 2 hours and 24 hours in both groups was recorded.

Results:

Twenty minutes after cardiopulmonary resuscitation, the pH value and the arterial partial pressure of oxygen (PaO(2)) of the AutoPulse group (n=29) were significantly higher than those of the standard manual external chest compression group [n=28, pH value: 7.142±0.134 vs. 7.010±0.136, PaO(2) (mm Hg, 1 mm Hg= 0.133 kPa): 71.92±9.59 vs. 65.61±7.66, both P<0.01], the arterial partial pressure of carbon dioxide (PaCO(2)) and NT-proBNP were significantly lower than those of the standard manual external chest compression group [PaCO(2) (mm Hg): 39.43±14.09 vs. 51.07±16.31, NT-proBNP (ng/L): 548.18±256.93 vs. 699.40±303.35, P<0.01 and P<0.05]. The 2-hour survival rate in AutoPulse group was higher than that in the standard manual external chest compression group, the disparity of the two groups was statistically significant [74.4% (32/43) vs. 52.4% (22/42), P<0.05]. Though the 24-hour survival rate of AutoPulse group was higher than that of the standard manual external chest compression group, the difference was not statistically significant [9.3% (4/43) vs. 4.8% (2/42), P>0.05].

Conclusion:

The device of AutoPulse can improve the tissue perfusion in patients with CA. Though this device may give rise some benefit in resuscitation for a short time, there is no decisive improvement in term of outcome of the patient.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 57)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
CPP	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☑	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

Mechanical chest compressions improve short-term outcome in patients requiring CPR during transport

Lundy D, McGeorge W, Silver A. *Circulation*. 2009;120:S1470-71.

Aim:

Chest compression (CC) quality is compromised during patient transport due to the difficulty of performing CC in a moving ambulance. Mechanical CC devices can be utilized to improve CC quality during transport; however, it is presently unclear whether cardiac arrest patient outcome is improved with use of mechanical CC devices during transport. We tested the hypothesis that use of a mechanical CC device would lead to improved resuscitation success for cardiac arrest patients during transport.

Methods:

The records of 617 consecutive non-traumatic cardiac arrest patients treated and transported by Charleston County EMS between January 2004 and January 2007 were reviewed to identify patients that were transported with ongoing CPR. A total of 509 patients met the criteria of not achieving return of spontaneous circulation (ROSC) at the scene and of being transported with ongoing CPR. During the study period, the agency gradually equipped its ambulances with mechanical chest compression devices (AutoPulse, ZOLL Medical); thus, 50% of patients were treated with LDB-CC and 50% were treated with manual CC.

Results:

Overall, 55 (11%) patients achieved ROSC for the first time during transport. Patients treated with the mechanical CC were more likely to achieve ROSC during transport compared with patient treated with manual CC (14.3% vs. 6.7%, p=0.005). Duration of EMS treatment at the scene was shorter for patients that achieved ROSC during transport vs. those that did not (20.7±6.1 min ROSC vs. 23.0±7.9 min no ROSC, p=0.03). There were no differences in age, gender, witnessed arrest, EMS witnessed arrest, location of arrest, bystander CPR, initial rhythm, or response time (all p 0.2). Of the 55 patients that achieved ROSC during transport, 44 (80%) qualified for transport according to ALS termination of resuscitation protocols.

Conclusion:

Patients treated with mechanical CC during transport are more likely to be resuscitated during transport compared with patients receiving manual CC presumably due to improved CC quality during transport.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 509)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Systolic BP	☐	☐
CPP	☐	☐
ROSC	☑	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

The impact of a new CPR assist device on rate of return of spontaneous circulation in out-of-hospital cardiac arrest

Casner M, Andersen D, Isaacs SM. *Prehosp Emerg Care*. 2005;9:61-67.

Objective:

The San Francisco Fire Department deployed an automated, load-distributing-band chest compression device (AutoPulse, Revivant Corporation) to evaluate its function in a large urban emergency medical services (EMS) service. A retrospective chart review was undertaken to determine whether the AutoPulse had altered short-term patient outcome, specifically, return of spontaneous circulation (ROSC).

Methods:

AutoPulse cardiopulmonary resuscitation (A-CPR) was used by paramedic captains responding to adult cardiac arrests with an average +/-SD response time of 15 +/- 5 minutes. The primary endpoint was patient arrival to an emergency department with measurable spontaneous pulses. The manual CPR comparison group was case-matched for age, gender, initial presenting electrocardiogram rhythm, and the number of doses of Advanced Cardiac Life Support medications as a proxy for treatment time. Matching was performed by an investigator blinded to outcome and treatment group.

Results:

Sixty-nine AutoPulse uses were matched to 93 manual-CPR-only cases. A-CPR showed improvement in the primary outcome when compared with manual CPR with any presenting rhythm (A-CPR 39%, manual 29%, $p = 0.003$). When patients were classified by first presenting rhythm, shockable rhythms showed no difference in outcome (A-CPR 44%, manual 50%, $p = 0.340$). Outcome was improved with A-CPR in initial presenting asystole and approached significance with pulseless electrical activity (PEA) (asystole: A-CPR 37%, manual 22%, $p = 0.008$; PEA: A-CPR 38%, manual 23%, $p = 0.079$).

Conclusion:

The AutoPulse may improve the overall likelihood of sustained ROSC and may particularly benefit patients with nonshockable rhythms. A prospective randomized trial comparing the AutoPulse with manual CPR in the setting of out-of-hospital sudden cardiac arrest is under way.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 162)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusions Pressure	☐	☐
ROSC	☑	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

Effect of the AutoPulse™ automated band chest compression device on hemodynamics in out-of-hospital cardiac arrest resuscitation

Duchateau FX, Gueye P, Curac S, et al. *Intensive Care Med.* 2010;36:1256-60.

Purpose:

Guidelines for advanced life support of cardiac arrest (CA) emphasize continuous and effective chest compressions as one of the main factors of cardiopulmonary resuscitation (CPR) success. The use of an automated load distributing chest compression device for CPR is promising but initial studies on survival show contradictory results. The aim of this study was to evaluate the effects of AutoPulse™ on blood pressure (BP) in out-of-hospital CA patients.

Methods:

This prospective study included adult patients presenting with in refractory out-of-hospital CA. Invasive arterial BP produced by AutoPulse™ was compared to BP generated by manual CPR (Active Compression Decompression). Systolic, diastolic and mean BP and end-tidal carbon dioxide were recorded before and after initiating the automated band device for each patient. The comparison of diastolic BP produced by manual CPR versus automated chest compressions was the primary end point.

Results:

Hemodynamics in 29 patients are reported and analyzed. Median diastolic BP increased after starting AutoPulse™ from 17[11–25] mmHg to 23[18–28] mmHg (P\0.001). Median systolic BP increased from 72[55–105] mmHg to106[78–135] mmHg (P = 0.02). Mean BP increased from 29[25–38] mmHg to 36[30–15] mmHg (P = 0.002). On the other hand, End-Tidal CO_2 did not increase significantly with AutoPulse™ (21[13–36] vs. 22[12–35] mmHg, P = 0.80).

Conclusion:

In patients with out-of-hospital CA, the use of Auto-Pulse™ is associated with an increased diastolic BP compared to manual chest compressions. While its benefit to survival has yet to be demonstrated, the increase in diastolic and mean BP is a promising outcome for AutoPulse™ use.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 29)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☑	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☑

-AutoPulse™ compared with standard chest compressions for out-of-hospital resuscitation: A matched case–control study

Jennings PA, Harriss L, Bernard S, et al. *Resuscitation*. 2010;81:S20.

Aim:

To compare the rates of survival to hospital (pulse on arrival at hospital) and survival to hospital discharge between conventional cardiopulmonary resuscitation (C-CPR) and automated CPR (A-CPR using AutoPulse®) in adults following out-of-hospital cardiac arrest (OHCA).

Methods:

We conducted a matched case-control study deploying AutoPulse® across three study sites in Victoria, Australia. Each case was matched to at least two (maximum four) controls using age, gender, response time, presenting cardiac rhythm and bystander CPR, and analysed using conditional logistic regression.

Results:

During the period October 2006 to April 2010 there were 66 OHCA where A-CPR was administered. These were matched to 220 like controls (mean 3.3 controls per case). There were no significant differences in demographic characteristics between the two groups. Survival to hospital was achieved in 25.8% (17/66) of OHCAs receiving A-CPR compared with 19.6% (43/220) for those receiving C-CPR, however this finding was not statistically significant (UOR 1.53; 95% CI 0.75–3.12; p =0.240). Survival to hospital discharge was achieved in 3.0% (2/66) of people receiving A-CPR compared with 6.8% (15/220) of those receiving C-CPR, however this also was not statistically significant (UOR 2.20; 95% CI 0.47–10.42; p = 0.318). For sub-group analysis, we removed OHCAs of non-cardiac aetiology (A-CPR = 9; C-CPR = 9) and those which were witnessed by EMS (A-CPR = 8; C-CPR = 26). Survival to hospital was achieved in 32% (16/50) of people receiving A-CPR compared with 19.8% (37/187) of those receiving C-CPR (UOR 1.91; 95% CI 0.95–3.82; p= 0.068). Survival to hospital discharge was achieved in 2% (1/50) of people receiving A-CPR and 6.4% of C-CPR (UOR 0.30; 95% CI 0.04–2.34; p = 0.250).

Conclusion:

We identified a trend towards improved survival to hospital in the A-CPR group but there was no difference in overall survival to hospital discharge. This warrants further investigation in studies with larger numbers.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 286)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☑
Survival (Discharge)	☐	☑
$EtCO_2$	☐	☐

Manual chest compression vs use of an automated chest compression device during resuscitation following out-of-hospital cardiac arrest

Hallstrom A, Rea TD, Sayre MR, et al. *JAMA*. 2006;295:2620-28.

Aim:

High-quality cardiopulmonary resuscitation (CPR) may improve both cardiac and brain resuscitation following cardiac arrest. Compared with manual chest compression, an automated load-distributing band (LDB) chest compression device produces greater blood flow to vital organs and may improve resuscitation outcomes.

Objective:

To compare resuscitation outcomes following out-of-hospital cardiac arrest when an automated LDB-CPR device was added to standard emergency medical services (EMS) care with manual CPR.

Design, Setting, and Patients:

Multicenter, randomized trial of patients experiencing out-of-hospital cardiac arrest in the United States and Canada. The a priori primary population was patients with cardiac arrest that was presumed to be of cardiac origin and that had occurred prior to the arrival of EMS personnel. Initial study enrollment varied by site, ranging from late July to mid November 2004; all sites halted study enrollment on March 31, 2005.

Intervention:

Standard EMS care for cardiac arrest with an LDB-CPR device (n=554) or manual CPR (n=517).

Main Outcome Measures:

The primary end point was survival to 4 hours after the 911 call. Secondary end points were survival to hospital discharge and neurological status among survivors.

Results:

Following the first planned interim monitoring conducted by an independent data and safety monitoring board, study enrollment was terminated. No difference existed in the primary end point of survival to 4 hours between the manual CPR group and the LDB-CPR group overall (N=1071; 29.5% vs 28.5%; P=.74) or among the primary study population (n=767; 24.7% vs 26.4%, respectively; P=.62). However, among the primary population, survival to hospital discharge was 9.9% in the manual CPR group and 5.8% in the LDB-CPR group (P=.06, adjusted for covariates and clustering). A cerebral performance category of 1 or 2 at hospital discharge was recorded in 7.5% of patients in the manual CPR group and in 3.1% of the LDB-CPR group (P=.006).

Conclusions:

Use of an automated LDB-CPR device as implemented in this study was associated with worse neurological outcomes and a trend toward worse survival than manual CPR. Device design or implementation strategies require further evaluation.

Device Studied

- ☑ AutoPulse® System
- ☐ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 1,071)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☑
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

A pilot study of mechanical chest compressions with the LUCAS™ device in cardiopulmonary resuscitation

Smekal D, Johansson J, Huzevka T, et al. *Resuscitation*. 2011;82:702-6.

Aim:

The LUCAS™ device has been shown to improve organ perfusion during cardiac arrest in experimental studies. In this pilot study the aim was to compare short-term survival between cardiopulmonary resuscitation (CPR) performed with mechanical chest compressions using the LUCAS™ device and CPR performed with manual chest compressions. The intention was to use the results for power calculation in a larger randomised multicentre trial.

Methods:

In a prospective pilot study, from February 1, 2005, to April 1, 2007, 149 patients with out-of-hospital cardiac arrest in two Swedish cities were randomised to mechanical chest compressions or standard CPR with manual chest compressions.

Results:

After exclusion, the LUCAS and the manual groups contained 75 and 73 patients, respectively. In the LUCAS and manual groups, spontaneous circulation with a palpable pulse returned in 30 and 23 patients ($p = 0.30$), spontaneous circulation with blood pressure above 80/50 mmHg remained for at least 5 min in 23 and 19 patients ($p = 0.59$), the number of patients hospitalised alive >4 h were 18 and 15 ($p = 0.69$), and the number discharged, alive 6 and 7 ($p = 0.78$), respectively.

Conclusion:

In this pilot study of out-of-hospital cardiac arrest patients we found no difference in early survival between CPR performed with mechanical chest compression with the LUCAS™ device and CPR with manual chest compressions. Data have been used for power calculation in a forthcoming multicentre trial.

Device Studied

- ☐ AutoPulse® System
- ☑ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 148)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☑
CPR Fraction	☐	☐
Survival (Admission)	☐	☑
Survival (Discharge)	☐	☑
$EtCO_2$	☐	☐

Mechanical active compression-decompression cardiopulmonary resuscitation (ACD-CPR) versus manual CPR according to pressure of end tidal carbon dioxide ($P_{ET}CO_2$) during CPR in out-of-hospital cardiac arrest (OHCA)

Axelsson C, Karlsson T, Axelsson AB, et al. *Resuscitation*. 2009;80:1099-1103.

Aim:

In animal and human studies, measuring the pressure of end tidal carbon dioxide ($P_{ET}CO_2$) has been shown to be a practical non-invasive method that correlates well with the pulmonary blood flow and cardiac output (CO) generated during cardiopulmonary resuscitation (CPR). This study aims to compare mechanical active compression-decompression (ACD) CPR with standard CPR according to $P_{ET}CO_2$ among patients with out-of-hospital cardiac arrest (OHCA), during CPR and with standardised ventilation.

Methods:

This prospective, on a cluster level, pseudo-randomised pilot trial took place in the Municipality of Göteborg. During a 2-year period, all patients aged >18 years suffering an out-of-hospital cardiac arrest (OHCA) of presumed cardiac etiology were enrolled. The present analysis included only tracheally intubated patients in whom $P_{ET}CO_2$ was measured for 15 min or until the detection of a pulse-giving rhythm.

Results:

In all, 126 patients participated in the evaluation, 64 patients in the mechanical chest compression group and 62 patients in the control group. The group receiving mechanical ACD-CPR obtained the significantly highest $P_{ET}CO_2$ values according to the average ($p = 0.04$), initial ($p = 0.01$) and minimum ($p = 0.01$) values. We found no significant difference according to the maximum value between groups.

Conclusion:

In this hypothesis generating study mechanical ACD-CPR compared with manual CPR generated the highest initial, minimum and average value of $P_{ET}CO_2$. Whether these data can be repeated and furthermore be associated with an improved outcome after OHCA need to be confirmed in a large prospective randomized trial.

Device Studied

- ☐ AutoPulse® System
- ☑ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 126)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☑	☐

Quality of cardiopulmonary resuscitation before and during transport in out-of-hospital cardiac arrest

Olasveengen TM, Wik L, Steen PA. *Resuscitation*. 2008;76:185-90.

Aim of the Study:

To evaluate quality of cardiopulmonary resuscitation (CPR) performed during transport after out-of-hospital cardiac arrest.

Materials and Methods:

Retrospective, observational study of all non-traumatic cardiac arrest patients older than 18 years who received CPR both before and during transport between May 2003 and December 2006 from the community run EMS system in Oslo. Chest compressions and ventilations were detected from impedance changes in routinely collected
ECG signals, and hands-off ratio calculated as time without chest compressions divided by total CPR time.

Results:

Seventy-five of 787 consecutive out-of-hospital cardiac arrest patients met the inclusion criteria. Quality data were available from 36 of 66 patients receiving manual CPR and 7 of 9 receiving mechanical CPR. CPR was performed for mean 21 ± 11 min before and 12 ± 8 min during transport. With manual CPR hands-off ratio increased from 0.19 ± 0.09 on-scene to 0.27 ± 0.15 (p = 0.002) during transport. Compression and ventilation rates were unchanged causing a reduction in compressions per minute from 94 ± 14 min−1 to 82 ± 19 min−1 (p = 0.001). Quality was significantly better with mechanical than manual CPR. Four patients (5%) survived to hospital discharge; two with manual CPR (Cerebral performance categories (CPC) 1 and 2), and two with mechanical CPR (CPC scores 3 and 4). No discharged patients had any spontaneous circulation during transport.

Conclusions:

The fraction of time without chest compressions increased during transport of out-of-hospital cardiac arrest patients. Every effort should therefore be made to stabilise patients on-scene before transport to hospital, but all transport with ongoing CPR is not futile.

Device Studied

- ☐ AutoPulse® System
- ☑ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 75)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☑
Survival (Admission)	☐	☐
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

Shock outcome prediction before and after CPR: A comparative study of manual and automated active compression–decompression CPR

Box MS, Watson JN, Addison PS, et al. *Resuscitation*. 2008;78:265-74.

Abstract

We report on a study designed to compare the relative efficacy of manual CPR (M-CPR) and automated mechanical CPR (ACD-CPR) provided by an active compression–decompression (ACD) device. The ECG signals of out-of-hospital cardiac arrest patients of cardiac aetiology were analysed just prior to, and immediately after, cardiopulmonary resuscitation (CPR) to assess the likelihood of successful defibrillation at these time points. The cardioversion outcome prediction (COP) measure previously developed by our group was used to quantify the probability of return of spontaneous circulation (ROSC) after counter-shock and was used as a measure of the efficacy of CPR. An initial validation study using COP to predict shock outcome from the patient data set resulted in a performance of 60% specificity achieved at 100% sensitivity on a blind test of the data. This is comparable with previous studies and provided confidence in the robustness of the technique across hardware platforms. Significantly, the COP marker also displayed an ability to stratify according to outcomes: asystole, ventricular fibrillation (VF), pulseless electrical activity (PEA), normal sinus rhythm (NSR). We then used the validated COP marker to analyse the ECG data record just prior to and immediately after the chest compression segments. This was initially performed for 87 CPR segments where VF was both the pre- and post-CPR waveform. An increase in the mean COP values was found for both CPR types. A signed rank sum test found the increase due to manual CPR not to be significant ($p > 0.05$) whereas the automated CPR was found to be significant ($p < 0.05$). This increase was larger for the automated CPR (1.26, $p = 0.024$) than for the manual CPR (0.99, $p = 0.124$). These results indicate that the application of CPR does indeed provide beneficial preparation of the heart prior to defibrillation therapy whether manual or automated CPR is applied. The COP marker shows promise as a definitive, quantitative determinant of the immediate positive effect of both types of CPR regardless of the details of use. In work of a more exploratory nature we then used the validated COP marker to analyse the ECG pre- and post-CPR for all rhythm types (212 traces). We show a significant increase in the COP measure ($p < 0.001$ in both cases) as indicated by a shift in the median COP marker distribution values. This increase was more pronounced for automated ACD-CPR than for manual CPR. However, a detailed statistical analysis carried out between the groups adjusted for pre-CPR value showed no significant difference between the two methods of CPR ($p = 0.20$). Similarly, adjusting for length of CPR showed no significant difference between the groups. Secondary, subgroup analysis of the ECG according to the length of time for which CPR was performed showed that both types of CPR led to an increase in the likelihood of successful defibrillation after increasing durations of CPR, however results were less reliable after longer periods of continuous CPR.

Device Studied

- ☐ AutoPulse® System
- ☑ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 54)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☐
CPR Fraction	☐	☐
Survival (Admission)	☐	☑
Survival (Discharge)	☐	☐
$EtCO_2$	☐	☐

Clinical consequences of the introduction of mechanical chest compression in the EMS system for treatment of out-of-hospital cardiac arrest—a pilot study

Axelsson C, Nestin J, Svensson L, et al. *Resuscitation*. 2006; 71:47-55.

Aim:

To evaluate the outcome among patients suffering from out-of-hospital cardiac arrest (OHCA) after the introduction of mechanical chest compression (MCC) compared with standard cardiopulmonary resuscitation (SCPR) in two emergency medical service (EMS) systems.

Methods:

The inclusion criterion was witnessed OHCA. The exclusion criteria were age <18 years, the following judged etiologies behind OHCA: trauma, pregnancy, hypothermia, intoxication, hanging and drowning or return of spontaneous circulation (ROSC) prior to the arrival of the advanced life support (ALS) unit. Two MCC devices were allocated during six-month periods between four ALS units for a period of two years (cluster randomisation).

Results:

In all, 328 patients fulfilled the criteria for participation and 159 were allocated to the MCC tier (the device was used in 66% of cases) and 169 to the SCPR tier.

In the MCC tier, 51% had ROSC (primary end-point) versus 51% in the SCPR tier. The corresponding values for hospital admission alive (secondary end-point) were 38% and 37% (NS). In the subset of patients in whom the device was used, the percentage who had ROSC was 49% versus 50% in a control group matched for age, initial rhythm, aetiology, bystander-/crew-witnessed status and delay to CPR. The percentage of patients discharged alive from hospital after OHCA was 8% versus 10% (NS) for all patients and 2% versus 4%, respectively (NS) for the patients in the subset (where the device was used and the matched control population).

Conclusion:

In this pilot study, the results did not support the hypothesis that the introduction of mechanical chest compression in OHCA improves outcome. However, there is room for further improvement in the use of the device. The hypothesis that this will improve outcome needs to be tested in further prospective trials.

Device Studied

- ☐ AutoPulse® System
- ☑ LUCAS® System with ACD
  (not cleared for use in the United States)
- ☐ LUCAS® 2 System

Study Design

- ☑ Human Trial (n = 328)
- ☑ Comparison made to manual CPR
- ☑ Statistical testing

Results Reported for Device	Improved	No Difference
Blood Pressure	☐	☐
Coronary Perfusion Pressure	☐	☐
ROSC	☐	☑
CPR Fraction	☐	☐
Survival (Admission)	☐	☑
Survival (Discharge)	☐	☑
$EtCO_2$	☐	☐

[1]Not cleared for use in the United States.