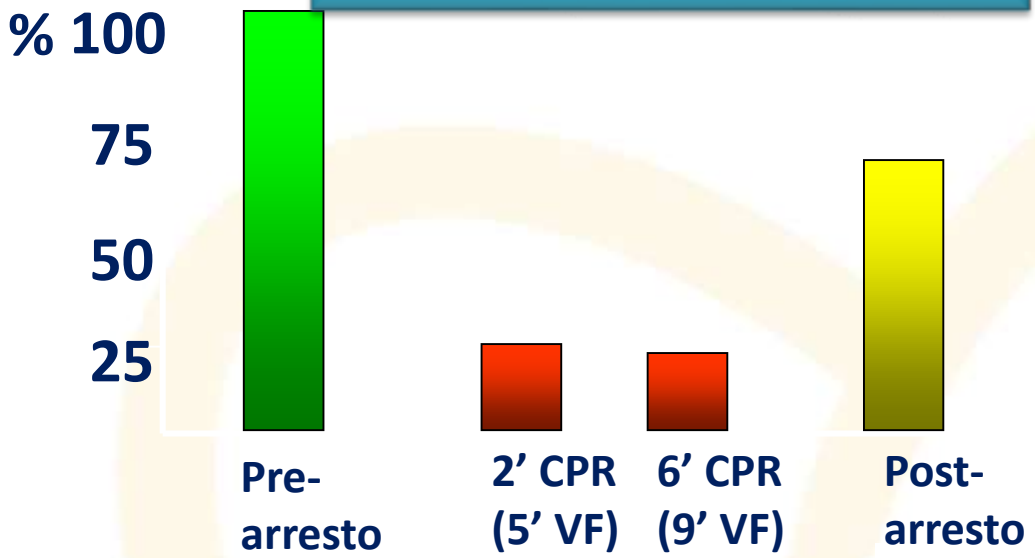
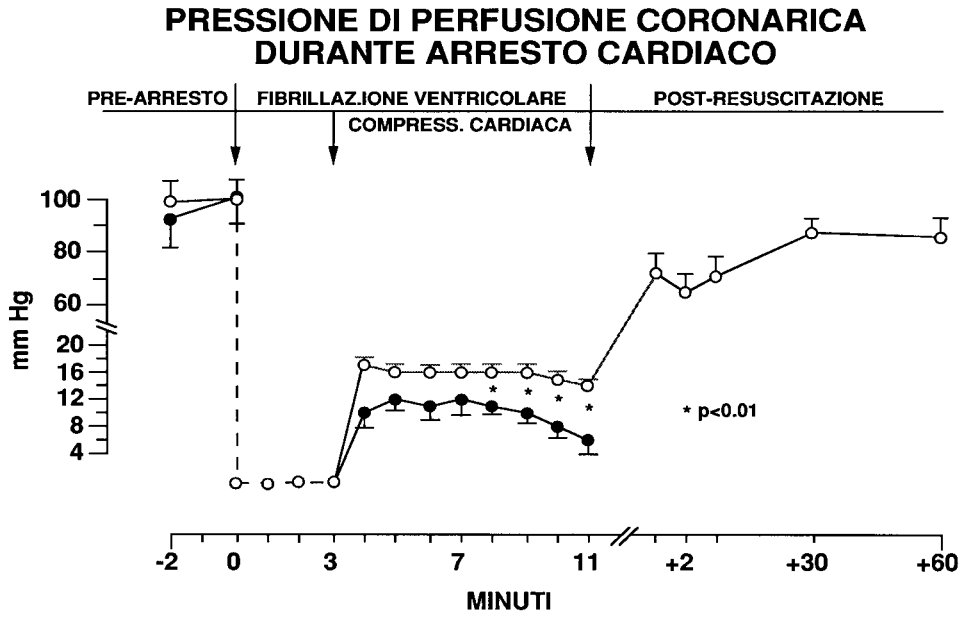
# RCP Meccanica

*Fulvio Kette*

# Devices for external chest compression


# Gittata cardiaca durante RCP

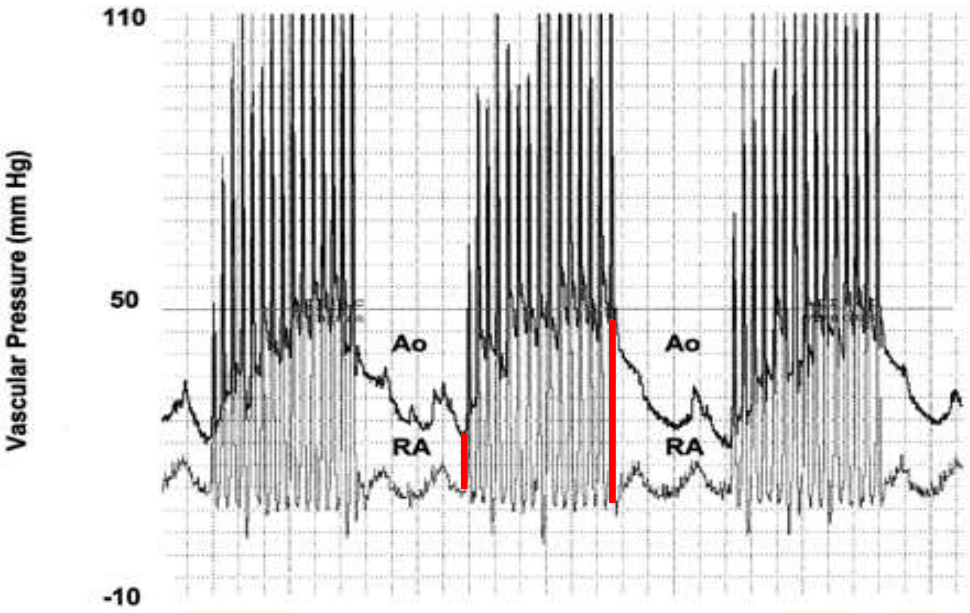


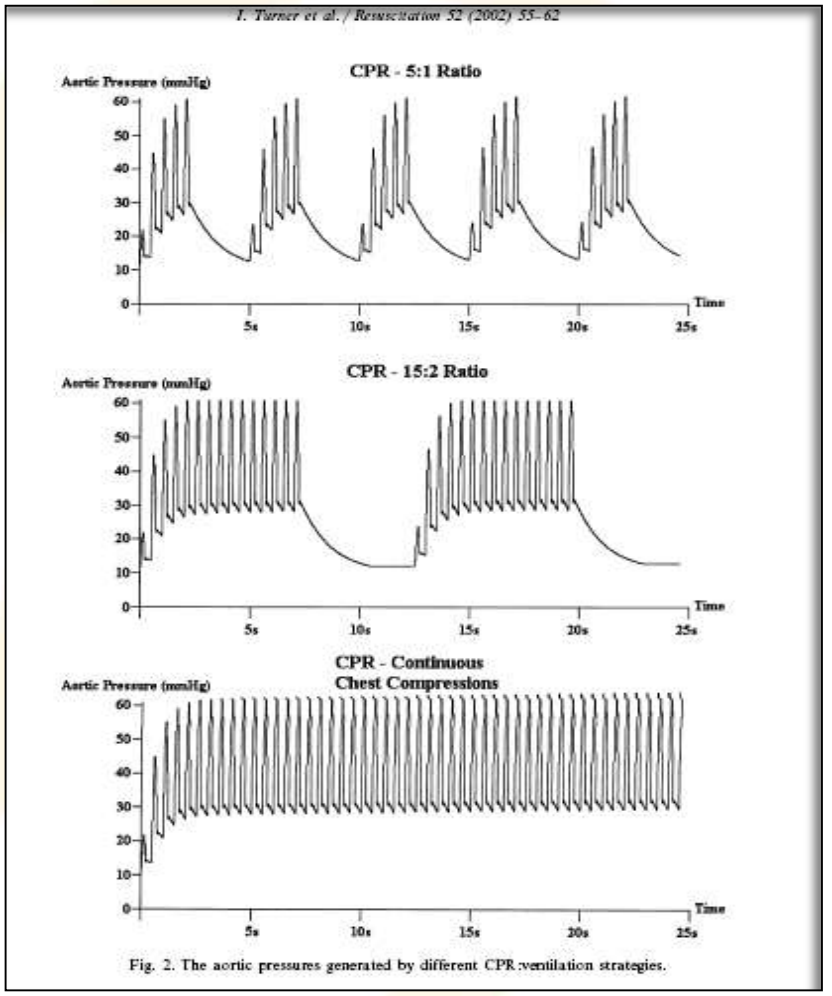



FK, UHS/CMS USA

# Coronary Perfusion Pressure during CPR




**Berg RA, *Circulation* 2001;104:2465**



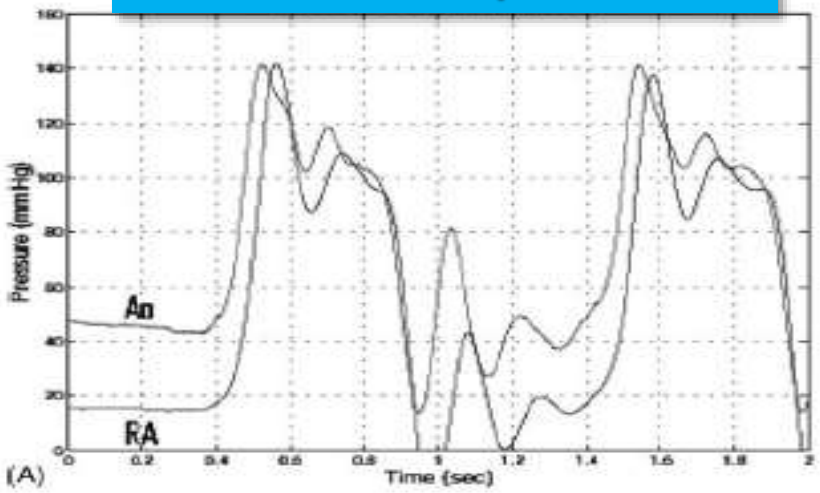

**Turner RA, Resuscitation 2002;52:55**

Based upon an **anecdotal report of successful resuscitation using a toilet plunger,** Cohen and co-workers have developed and investigated a hand-held suction cup as an adjunct to standard manual CPR.

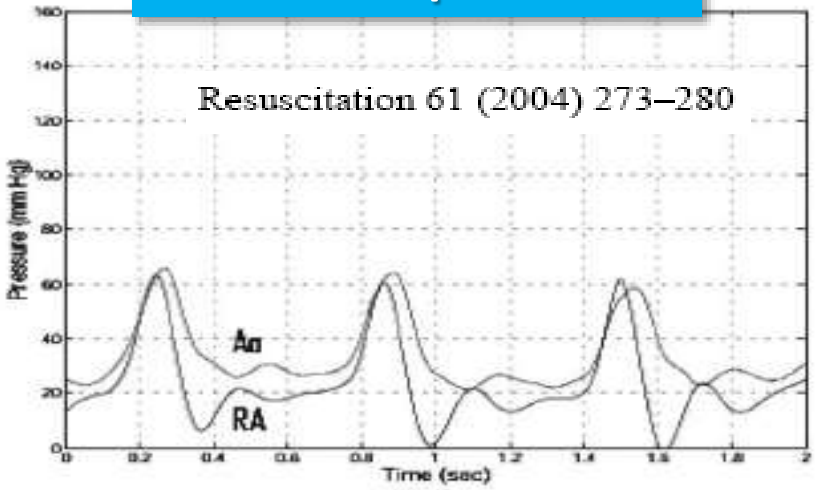
Resuscitation. 1994 Jul;28(1):1-7.
**Clinical and laboratory investigations of active compression-decompression cardiopulmonary resuscitation.**
Tucker KJ, Idris A.

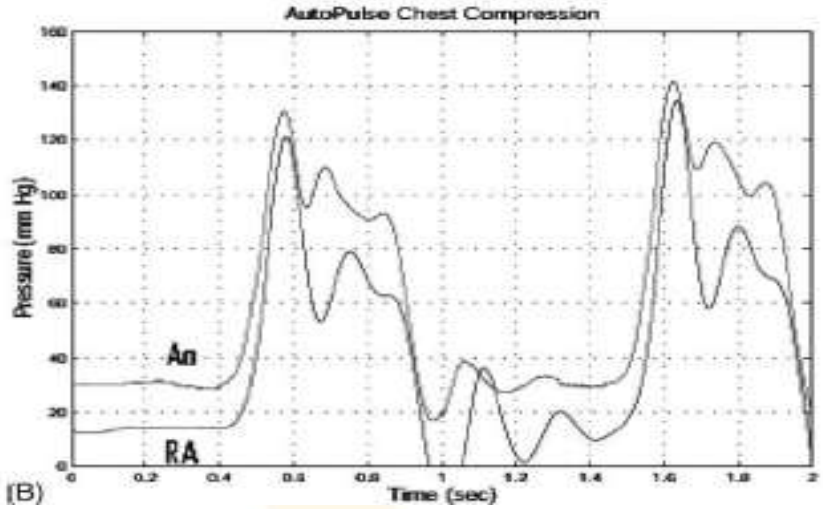
# I massaggiatori esterni

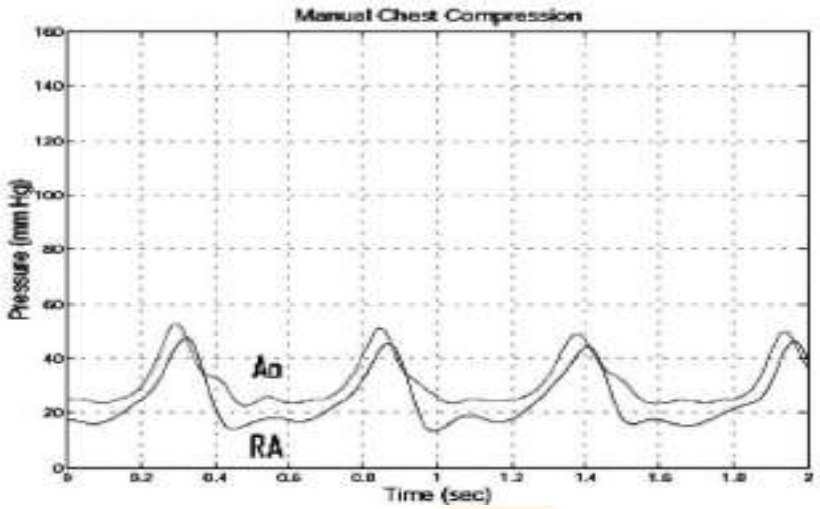

## Mechanical compression




## Manual compression




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

Sergio Timerman[a], Luis Francisco Cardoso[a], Jose A.F. Ramires[a], Henry Halperin[b,*]

MR, FK, AREU, 10/12

Resuscitation. 2002 Dec;55(3):285-99.

**Evaluation of LUCAS, a new device for automatic mechanical compression and active decompression resuscitation.**

Steen S, Liao Q, Pierre L, Paskevicius A, Sjöberg T.

# I massaggiatori automatici

**Relativamente semplici da utilizzare in ambito intra ed extraospedaliero**

**Efficace e relativamente stabile pressione di perfusione coronarica**

**Liberano personale durante la RCP**

**Permettono di defibrillare senza interrompere le compressioni**

**Consentono di spostare pazienti con RCP in corso**

**Garantiscono compressioni efficaci anche durante il trasporto in ambulanza**

**Consentono di effettuare TC ed altri interventi invasivi (PCI, ECMO) senza interrompere le compressioni toraciche**

# Cardiopulmonary Resuscitation With a Novel Chest Compression Device in a Porcine Model of Cardiac Arrest

JACC Vol. 44, No. 11, 2004
December 7, 2004:2214–20

## Improved Hemodynamics and Mechanisms

Henry R. Halperin, MD, MA,*†‡ Norman Paradis, MD,§ Joseph P. Ornato, MD, FACC,‖
Menekhem Zviman, PHD,* Jennifer LaCorte, RN,* Albert Lardo, PHD,* Karl B. Kern, MD, FACC¶
*Baltimore, Maryland; Denver, Colorado; Richmond, Virginia; and Tucson, Arizona*

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

Sergio Timerman[a], Luis Francisco Cardoso[a], Jose A.F. Ramires[a], Henry Halperin[b,*]

Resuscitation 61 (2004) 273–280

# THE IMPACT OF A NEW CPR ASSIST DEVICE ON RATE OF RETURN OF SPONTANEOUS CIRCULATION IN OUT-OF-HOSPITAL CARDIAC ARREST

Michael Casner, MD, David Andersen, BS, NREMT-P, S. Marshal Isaacs, MD

PREHOSPITAL EMERGENCY CARE 2005;9:61–67

# Use of an Automated, Load-Distributing Band Chest Compression Device for Out-of-Hospital Cardiac Arrest Resuscitation

JAMA, June 14, 2006—Vol 295, No. 22

MR, FK, AREU, 10/12

# Use of an Automated, Load-Distributing Band Chest Compression Device for Out-of-Hospital Cardiac Arrest Resuscitation

JAMA, June 14, 2006—Vol 295, No. 22 Ong MEH, Ornato JP et al

**783 pz vittime di ACC extraospedaliero : 499 trattate con RCP manuale (gennaio 2001 a marzo 2003)**
**284 selezionati per trattamento con Autopulse, trattati 210 (dicembre 2003 a marzo 2005).**

**Endpoint: ROSC, sopravvivenza all'arrivo in ospedale, dimissione dall'ospedale, outcome neurologico alla dimissione.**

**Dimissione dall'ospedale più elevata nel gruppo trattato con Autopulse.**

Manual Chest Compression vs Use of an Automated Chest Compression Device During Resuscitation Following Out-of-Hospital Cardiac Arrest

A Randomized Trial

JAMA, June 14, 2006—Vol 295, No. 22 (Reprinted)

Hallstrom A et al

**WORSE OUTCOME IN PATIENTS TREATED WITH AUTOPULSE**

**BUT, the negative result probabily is due to lack of training: too long hand off time during Autopulse preparation**

# ILCOR 2010 RECOMMENDATION

*The current status of LUCAS and AutoPulse*

Two large prospective randomised multicentre studies are currently underway to evaluate the LDB (AutoPulse) and the Lund University Cardiac Arrest System (LUCAS). The results of these studies are awaited with interest. In hospital, mechanical devices have been used effectively to support patients undergoing primary coronary intervention (PCI)[298,299] and CT scans[300] and also for prolonged resuscitation attempts (e.g., hypothermia,[301,302] poisoning, thrombolysis for pulmonary embolism, prolonged transport etc) where rescuer fatigue may impair the effectiveness of manual chest compression. In the prehospital environment where extrication of patients, resuscitation in confined spaces and movement of patients on a trolley often preclude effective manual chest compressions, mechanical devices may also have an important role. During transport to hospital, manual CPR is often performed poorly; mechanical CPR can maintain good quality CPR during an ambulance transfer.[303,304] Mechanical devices also have the advantage of allowing defibrillation without interruption in external chest compression. The role of mechanical devices in all situations requires further evaluation.

Original Investigation *JAMA*. 2014;311(1):53-61.

# 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

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

Resuscitation 85 (2014) 741–748

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]

Lancet 2015; 385: 947–55

# 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**

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

2589 pts, 6 EMS Services (Sweden, UK, Holland)

**LUCAS vs manual CC**

Jan 2008 – Aug 2012

| Outcomes | No. (%) of Participants | | *P* Value | Treatment Difference, % (95% CI) |
|---|---|---|---|---|
| | Mechanical CPR (n = 1300) | Manual CPR (n = 1289) | | |
| 4-Hour survival[a] | 307 (23.6) | 305 (23.7) | >.99 | −0.05 (−3.3 to 3.2) |
| ROSC[b] | 460 (35.4) | 446 (34.6) | .68 | 0.78 (−2.9 to 4.5) |
| Arrival at emergency department with palpable pulse | 366 (28.2) | 357 (27.7) | .83 | 0.46 (−3.0 to 3.9) |
| Survival to discharge from ICU with CPC 1-2[c] | 98 (7.5) | 82 (6.4) | .25 | 1.18 (−0.8 to 3.1) |
| Survival to hospital discharge with CPC 1-2[c] | 108 (8.3) | 100 (7.8) | .61 | 0.55 (−1.5 to 2.6) |
| 1-Month survival with CPC 1-2[d] | 105 (8.1) | 94 (7.3) | .46 | 0.78 (−1.3 to 2.8) |
| 6-Month survival with CPC 1-2[d] | 110 (8.5) | 98 (7.6) | .43 | 0.86 (−1.2 to 3.0) |
| Survival to discharge from ICU[e] | 158 (12.2) | 153 (11.9) | .86 | 0.28 (−2.2 to 2.8) |

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[c], Anne Whitehead[l], Ulrich R. Herken[m], E. Brooke Lerner[n]

4753 pts,

**Autopulse + vs high quality manual CC**

Mar 2009 – Jan 2011

Comparison of outcome by treatment arm.

| Outcomes | M-CPR ($n$ = 2132) | iA-CPR ($n$ = 2099) | Covariate adjusted odds ratio (95% CI) | Covariate and interim analyses adjusted odds ratio (95% CI)[b] |
|---|---|---|---|---|
| Survival to Hospital Discharge | 233 (11.0%) (7 cases unknown) | 196 (9.4%) (5 cases unknown) | 0.89 (0.72–1.10) | 1.06 (0.83–1.37)[a] |
| Survival to 24 h | 532 (25.0%) v | 456 (21.8%) (10 cases unknown) | 0.86 (0.74–0.998)[b] | |
| Sustained ROSC | 689 (32.3%) | 600 (28.6%) | 0.84 (0.73–0.96)[b] | |
| Discharge mRS | ($n$ = 233) | ($n$ = 196) | | |
| Score of 0–3 | 112 (48.1%) | 87 (44.4%) | 0.80 (0.47–1.37)[b] | |
| Score of 4–5 | 61 (26.2%) | 50 (25.5%) | | |
| Unknown score | 60 (25.8%) | 59 (30.1%) | | |

Lancet 2015; 385: 947–55

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

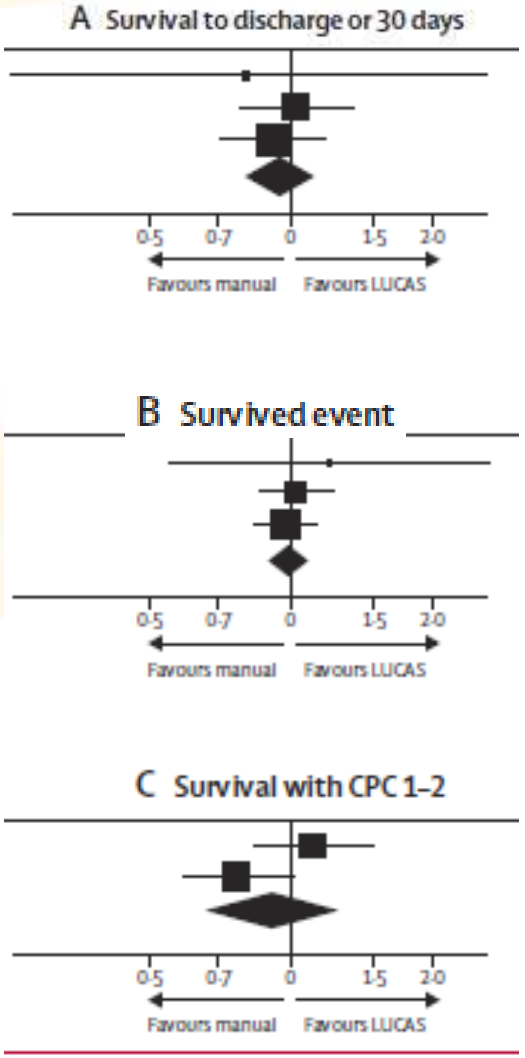
Gavin D Perkins, Ranjit Lall, Tom Quinn, Charles D Deakin, Matthew W Cooke, Jessica Horton, Sarah E Lamb, Anne-Marie Slowther, Malcolm Woollard, Andy Carson, Mike Smyth, Richard Whitfield, Amanda Williams, Helen Pocock, John J M Black, John Wright, Kyee Han, Simon Gates, PARAMEDIC trial collaborators*

4471pts, 4 UK Ambulance Services

**LUCAS 2 + vs high quality manual CC**

Apr 2010 – Jun 2013

| | LUCAS-2 (n=1652) | Control (n=2819) | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
|---|---|---|---|---|
| Survival to 30 days | | | | |
| Survived to 30 days | 104 (6%) | 193 (7%) | 0·91 (0·71–1·17) | 0·86 (0·64–1·15) |
| Not known | 0 | 1 (<1%) | .. | .. |
| ROSC | | | | |
| ROSC | 522 (32%) | 885 (31%) | 1·02 (0·89–1·16) | 0·99 (0·86–1·14) |
| Not known | 58 (4%) | 82 (3%) | .. | .. |
| Survived event | | | | |
| Survived event | 377 (23%) | 658 (23%) | 0·97 (0·83–1·14) | 0·97 (0·82–1·14) |
| Not known | 82 (5%) | 129 (5%) | .. | .. |
| Survival to 3 months | | | | |
| Survived to 3 months | 96 (6%) | 182 (6%) | 0·89 (0·69–1·15) | 0·83 (0·61–1·12) |
| Not known | 0 | 1 (<1%) | .. | .. |
| Survival to 12 months | 89 (5%) | 175 (6%) | 0·86 (0·60–1·12) | 0·83 (0·62–1·11) |
| Survival with favourable neurological outcome (CPC 1–2) | 77 (5%) | 168 (6%) | 0·77 (0·59–1·02) | 0·72 (0·52–0·99) |

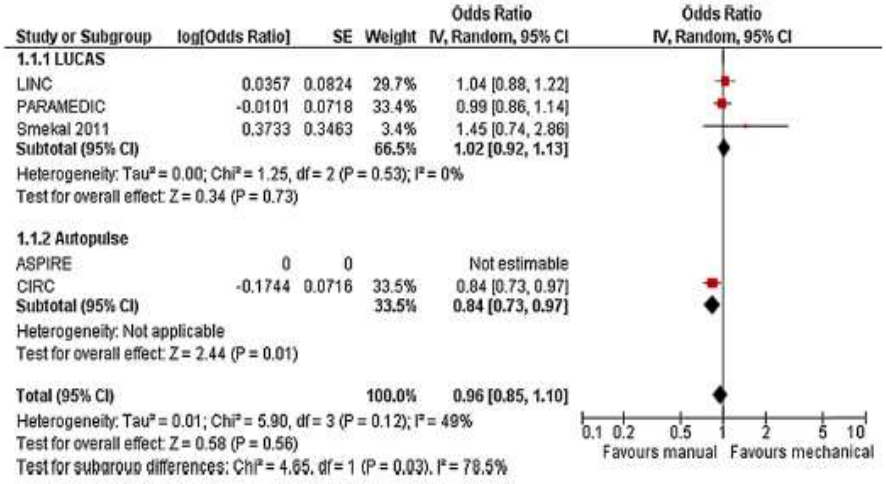


# Mechanical chest compression for out of hospital cardiac arrest: Systematic review and meta-analysis☆

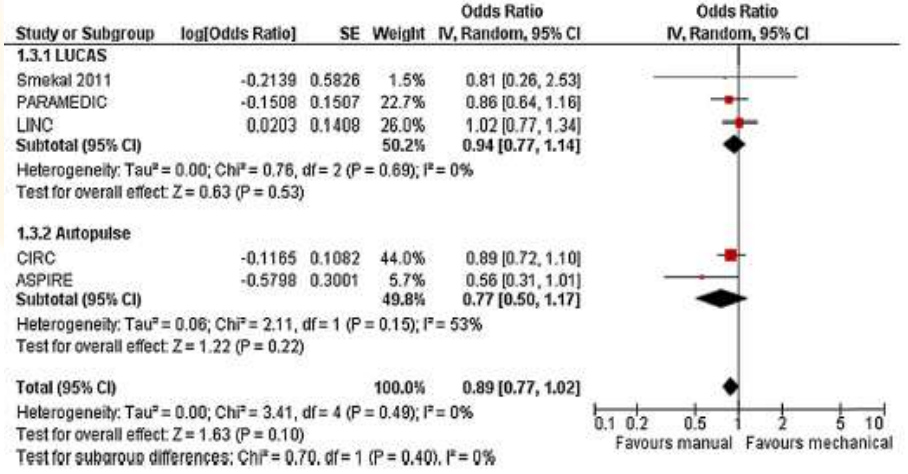
Simon Gates[a,*], Tom Quinn[b,g], Charles D. Deakin[c,d], Laura Blair[e], Keith Couper[a,f], Gavin D. Perkins[a]

Resuscitation 94 (2015) 91–97

ROSC




Survival to hosp. discharge or 30 days survival



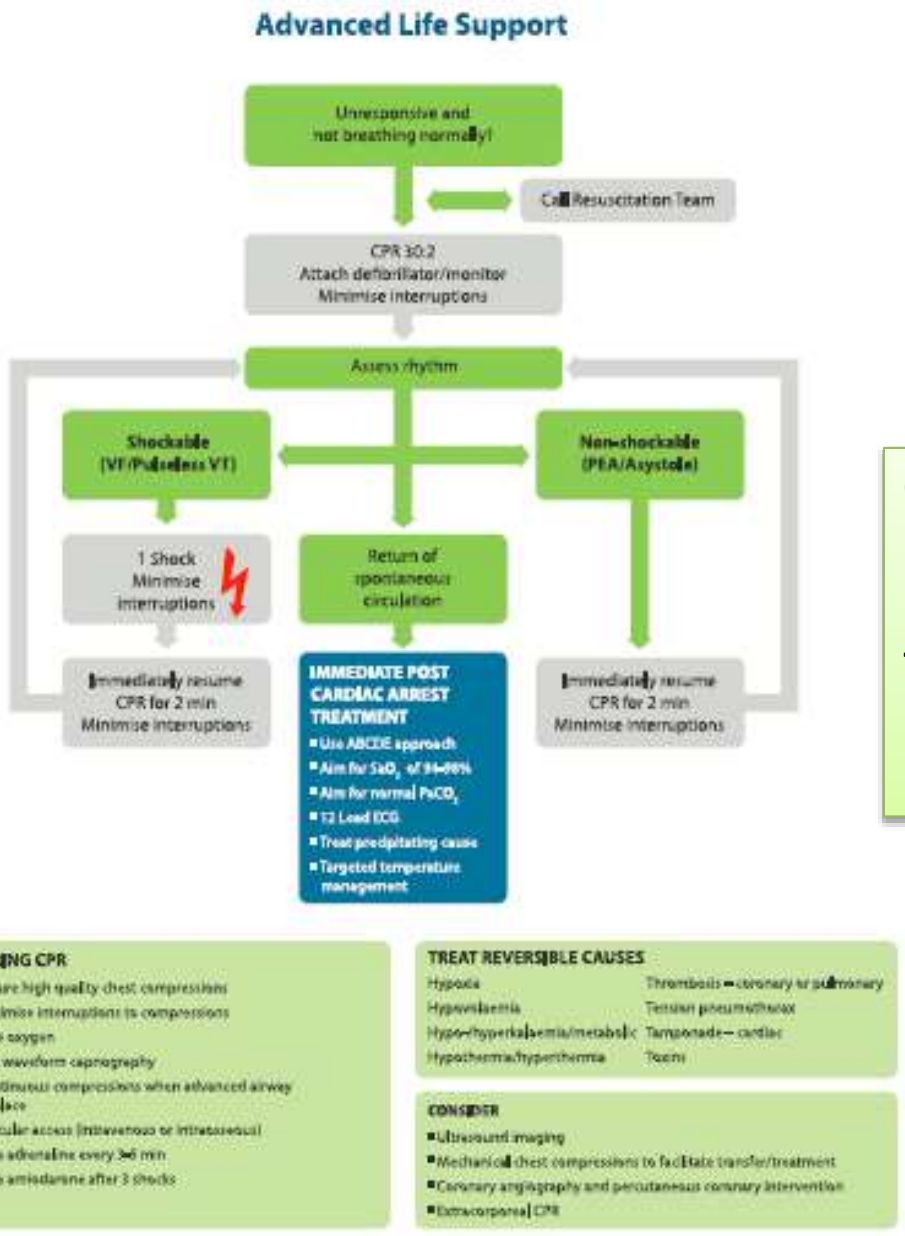
*Editorial / Resuscitation 85 (2014) 705–706*

# Manual chest compressions for cardiac arrest – With or without mechanical CPR?

Where services do use mechanical CPR devices, there need to be local clinical guidelines, extensive training and evaluation of processes and outcomes. In two-tier EMS systems, it would seem logical to confine mechanical CPR devices to the second tier. In this way, during the early stages of cardiac arrest management, the focus is on high-quality manual CPR and early defibrillation.

Mechanical CPR devices are also being used increasingly as a bridge to extra-corporeal cardiopulmonary resuscitation (ECPR).[16]

J. Soar, J. Nolan




**CONSIDER**

- Ultrasound imaging
- **Mechanical chest compression to facilitate transfer/treatment**
- Coronary angiography and PCI
- Extracorporeal CPR

# ILCOR 2015 RECOMMENDATIONS

We suggest that automated mechanical chest compression devices are not used routinely to replace manual chest compressions. We suggest that automated mechanical chest compression devices are a reasonable alternative to high-quality manual chest compressions in situations where sustained high-quality manual chest compressions are impractical or compromise provider safety, such as CPR in a moving ambulance, prolonged CPR