CPR: Role of adrenaline – Role of monitoring (etCO2) and mechanical devices.

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DECLARATION OF INTEREST

- I have nothing to declare

CPR: Role of adrenaline?

What do the ERC guidelines say?

Contents lists available at ScienceDirect

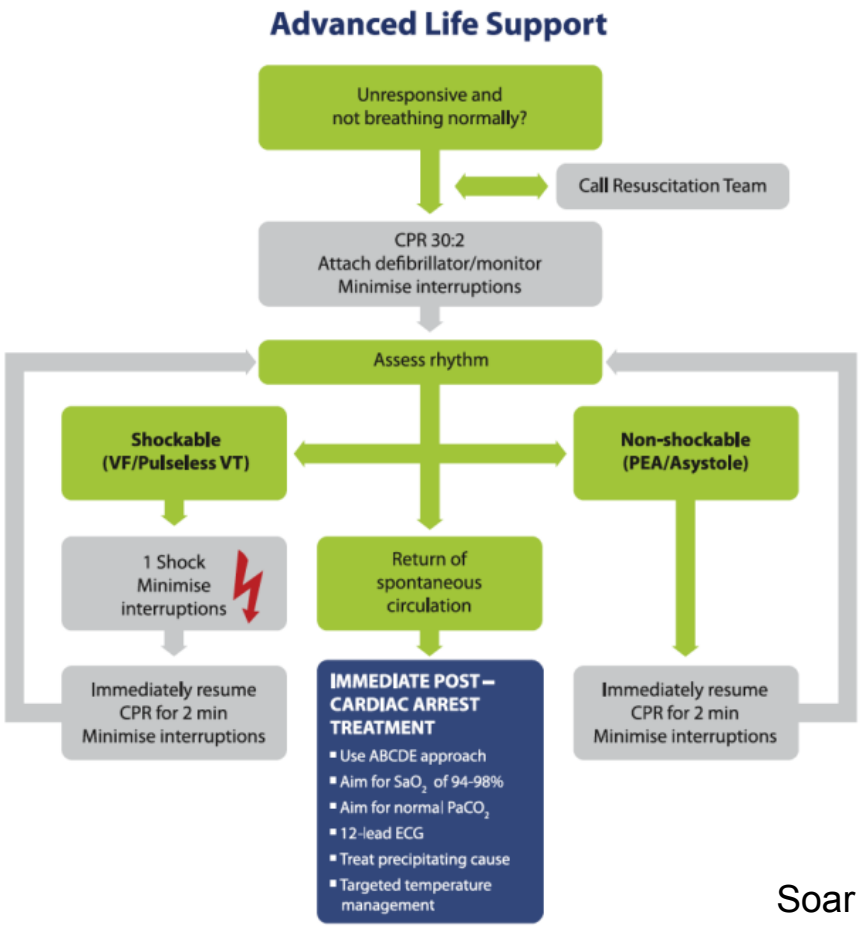
Resuscitation

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

European Resuscitation Council Guidelines for Resuscitation 2015
Section 3. Adult advanced life support

Jasmeet Soar[a,*], Jerry P. Nolan[b,c], Bernd W. Böttiger[d], Gavin D. Perkins[e,f], Carsten Lott[g], Pierre Carli[h], Tommaso Pellis[i], Claudio Sandroni[j], Markus B. Skrifvars[k], Gary B. Smith[l], Kjetil Sunde[m,n], Charles D. Deakin[o], on behalf of the Adult advanced life support section Collaborators[1]

ERC Guidelines for Resuscitation



Soar et al. Resuscitation 2015

CPR: Role of adrenaline?

DURING CPR

- Ensure high quality chest compressions
- Minimise interruptions to compressions
- Give oxygen
- Use waveform capnography
- Continuous compressions when advanced airway in place
- Vascular access (intravenous or intraosseous)
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks

ALS Section 3
ERC Guidelines 2015

- If IV/IO access has been obtained, during the next 2 min of CPR give adrenaline 1 mg and amiodarone 300 mg.[337]

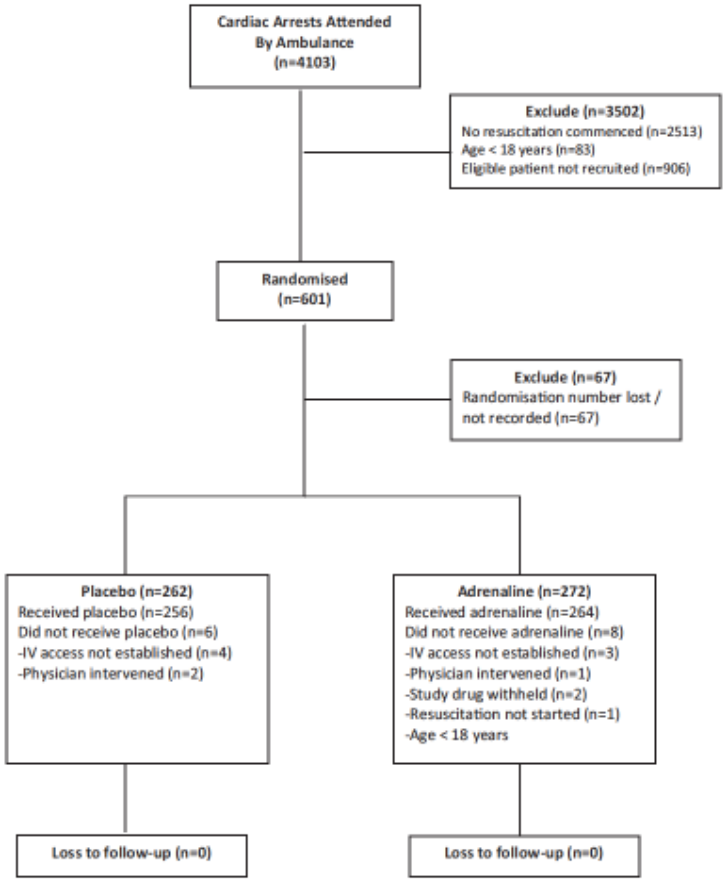
337. Karlis G, Iacovidou N, Lelovas P, et al. Effects of early amiodarone administration during and immediately after cardiopulmonary resuscitation in a swine model. Acta Anaesthesiol Scand 2014;58:114–22.

Soar et al. Resuscitation 2015

CPR: Role of adrenaline?

Evidence?

CPR: Role of adrenaline?



1:1 randomized, double blind, placebo controled trial of adrenalin administration in OHCA patients in AUS

Jacobs et al. Resuscitation 2011

CPR: Role of adrenaline?

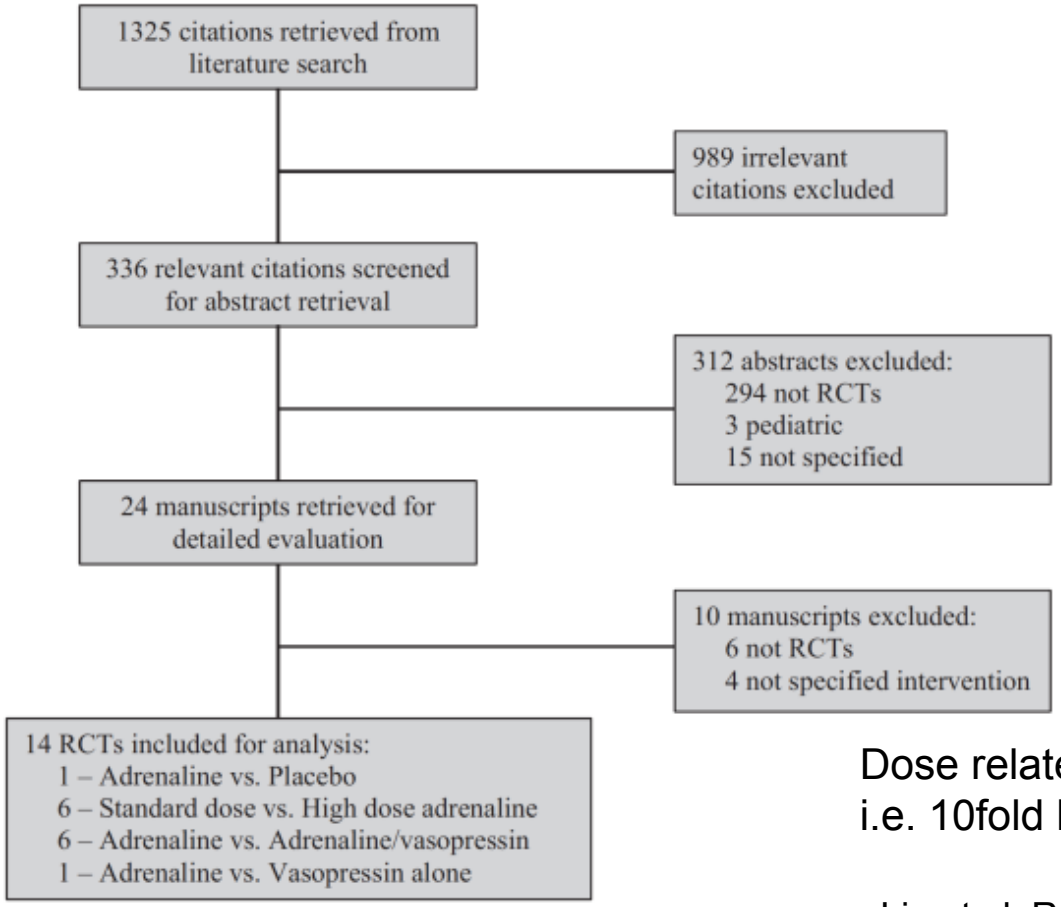
Outcome	Placebo ($n = 262$), n (%)	Adrenaline ($n = 272$), n (%)	p-Value
ROSC achieved pre-hospital	22 (8.4%)	64 (23.5%)	<0.001
Admitted to hospital	34 (13.0%)	69 (25.4%)	<0.001
Survived to hospital discharge	5 (1.9%)	11 (4.0%)	0.15
CPC 1 or 2	5 (100%)	9 (81.8%)	0.31

- increased portion of patients with ROSC and admission to hospital afer OHCA

- adrenaline failed to demonstrate improved hospital survival and neurological outcome

Jacobs et al. Resuscitation 2011

CPR: Role of adrenaline?



Dose related effects?
i.e. 10fold higher doses

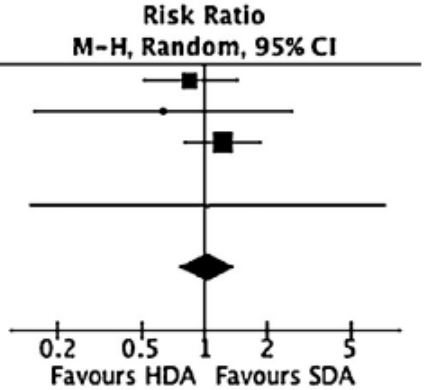
Lin et al. Resuscitation 2014

CPR: Role of adrenaline?

Survival to discharge

Study or Subgroup	SDA Events	SDA Total	HDA Events	HDA Total	Weight	Risk Ratio M-H, Random, 95% CI
Brown 1992	26	632	31	648	37.9%	0.86 [0.52, 1.43]
Callaham 1992	3	270	5	286	4.9%	0.64 [0.15, 2.63]
Gueugniaud 1998	46	1650	38	1677	54.7%	1.23 [0.80, 1.88]
Sherman 1997	0	62	0	78		Not estimable
Stiell 1992	2	165	2	170	2.6%	1.03 [0.15, 7.23]
Total (95% CI)		**2779**		**2859**	**100.0%**	**1.04 [0.76, 1.42]**
Total events	77		76			

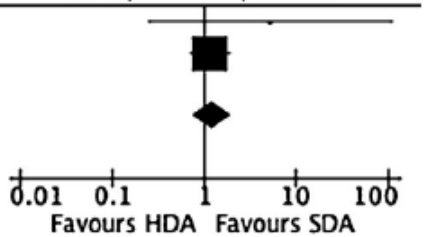
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.60$, df = 3 (P = 0.66); $I^2 = 0\%$
Test for overall effect: Z = 0.22 (P = 0.83)



CPC 1-2

Study or Subgroup	SDA Events	SDA Total	HDA Events	HDA Total	Weight	Risk Ratio M-H, Random, 95% CI
Callaham 1992	2	270	0	286	2.6%	5.30 [0.26, 109.80]
Gueugniaud 1998	33	1650	29	1677	97.4%	1.16 [0.71, 1.90]
Total (95% CI)		**1920**		**1963**	**100.0%**	**1.20 [0.74, 1.96]**
Total events	35		29			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.95$, df = 1 (P = 0.33); $I^2 = 0\%$
Test for overall effect: Z = 0.74 (P = 0.46)

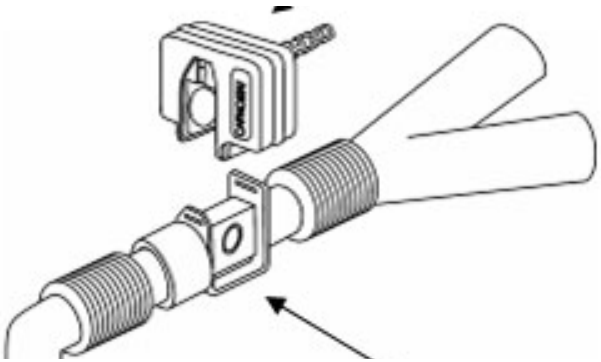


Lin et al. Resuscitation 2014

CPR: Role of adrenaline?

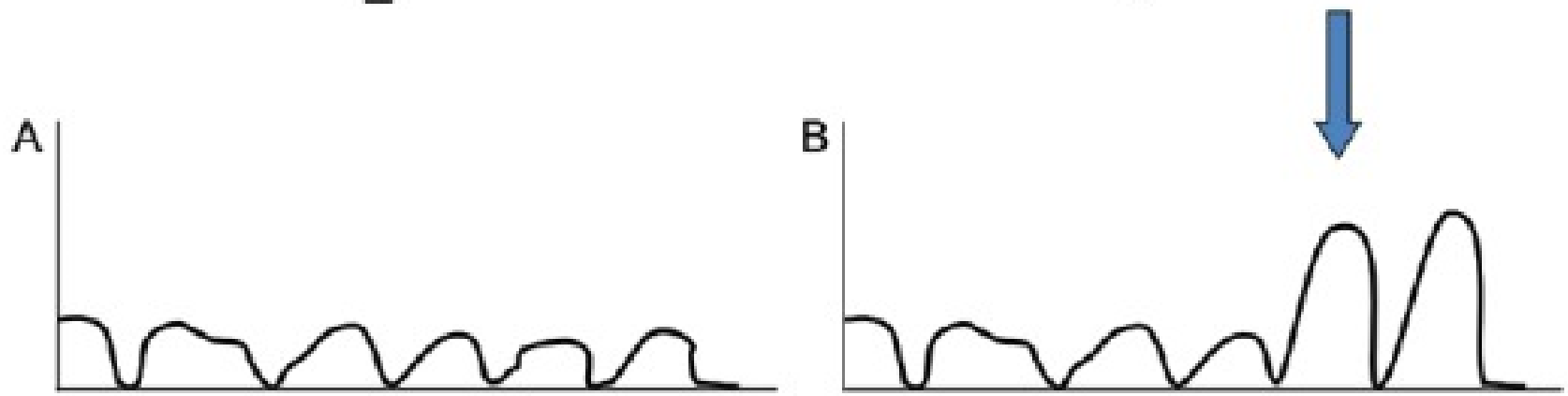
- Part of guideline recommended therapy in ALS
- Increases ROSC and hospital admission
- Fails to demonstrate improvement in survival at hospital discharge and neurological outcome
- Further RCT needed (PARAMEDIC-2 trial ongoing 8000 patients)

CPR: Role of $etCO_2$



CPR: Role of $etCO_2$

CO_2 waveform during CPR



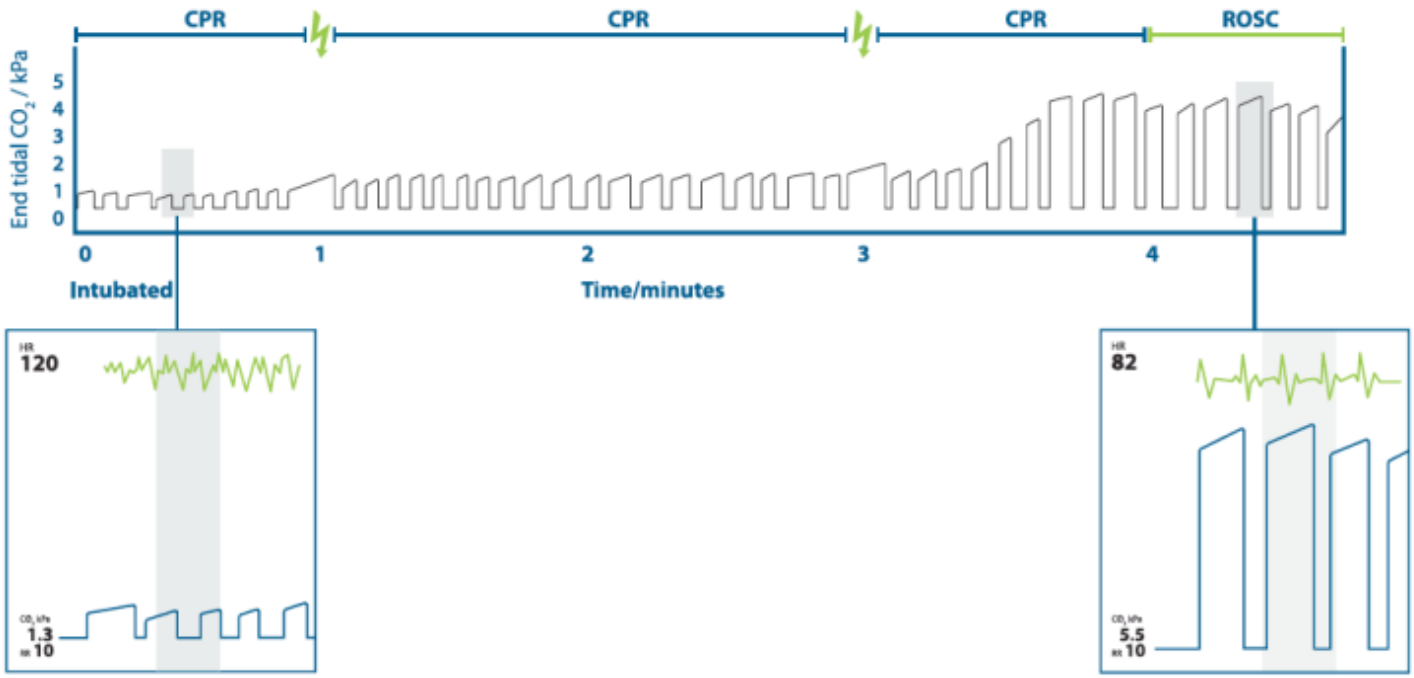
An abrupt increase in $PETCO_2$ may indicate return of spontaneous circulation (ROSC). Increase in pulmonary circulation brings more CO_2 into lungs for elimination

CPR: Role of $etCO_2$

ERC Guidelines 2015:

1. Ensuring tracheal tube placement Sheak et al. Resuscitation 2015
2. Monitoring ventilation rate
3. Monitoring quality of chest compression Hamrick JL et al J Am Heart Assoc 2014
4. Identifying ROSC under CPR

CPR: Role of $etCO_2$



ERC Guidelines 2015

CPR: Role of $etCO_2$

Ensuring tracheal tube placement

Appropriate documentation of confirmation of endotracheal tube position and relationship to patient outcome from in-hospital cardiac arrest☆

Michael P. Phelan[a,*], Joseph P. Ornato[b,c], Mary Ann Peberdy[b,c], Fredric M. Hustey[a], for the American Heart Association's Get With The Guidelines-Resuscitation Investigators[c]

[a] Emergency Services Institute, Cleveland Clinic, Cleveland Clinic Lerner College of Medicine, Case Western Reserve University, Cleveland, OH 44195, United States
[b] Department of Emergency Medicine, Virginia Commonwealth University Health System, 1250 East Marshall Street, Richmond, VA 23298, United States

Resuscitation 2013

CPR: Role of $etCO_2$

Ensuring tracheal tube placement:
Get with the guidelines resuscitation Registry GWTG-R
(176.504 patients)

	Unadjusted OR Mean [95% CI]	*p*	Adjusted OR Mean [95% CI]	*p*
ET confirmation method				
None	1		1	–
Auscultation	0.984 [0.941, 1.028]	0.471	0.988 [0.943, 1.036]	0.625
$P_{et}CO_2$ or EDD	1.196 [1.150, 1.244]	0.0001	1.229 [1.179, 1.282]	0.0001

Phelan et al. Resuscitation 2013

CPR: Role of mechanical devices

The effect of rescuer fatigue on the quality of chest compressions

F. Javier Ochoa [a,*], E. Ramalle-Gómara [b,c], V. Lisa [d], I. Saralegui [a]

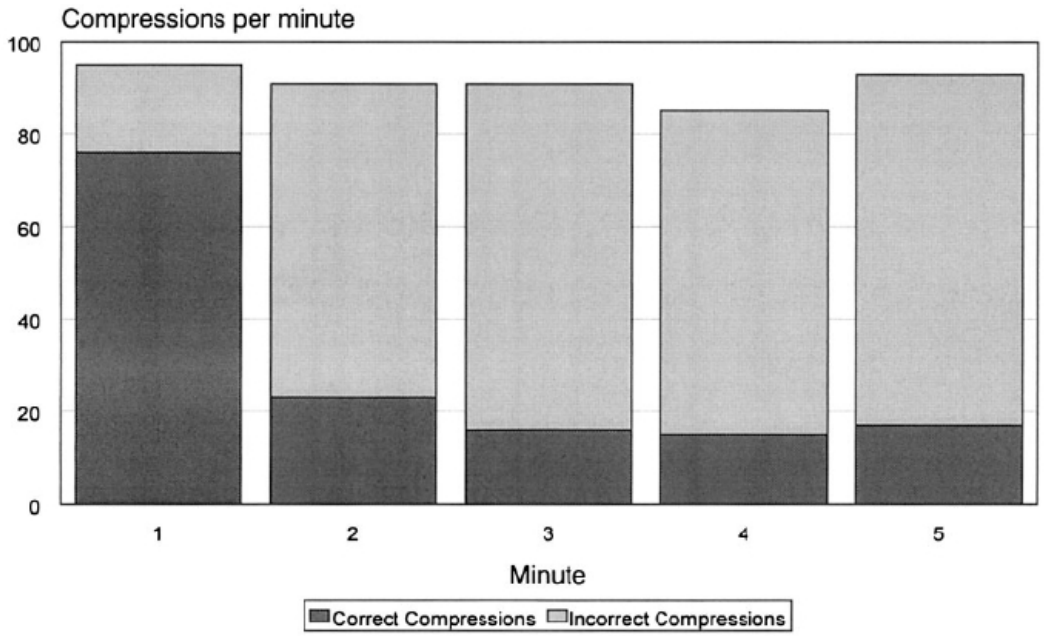


Fig. 1. The effect of the course of time on the quality of chest compressions.

Resuscitation 37 (1998) 149–152

CPR: Role of mechanical devices

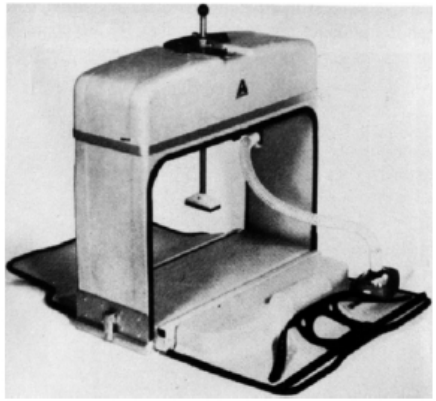


Fig. 19. Heart Reactivator Cardio Pulser.

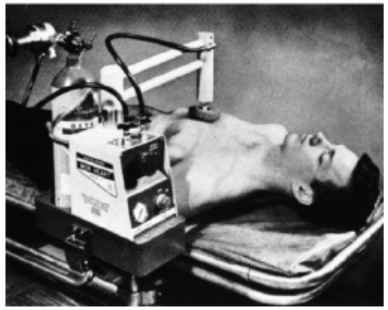
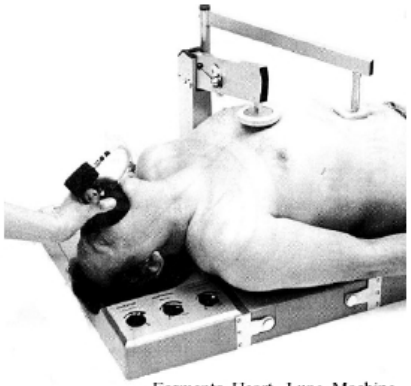


Fig. 4. Iron Heart gas powered.



Formenta Heart–Lung Machine.

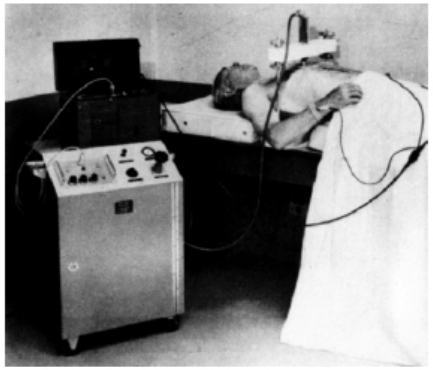


Fig. 17. Harkin Bramson electricity powered.

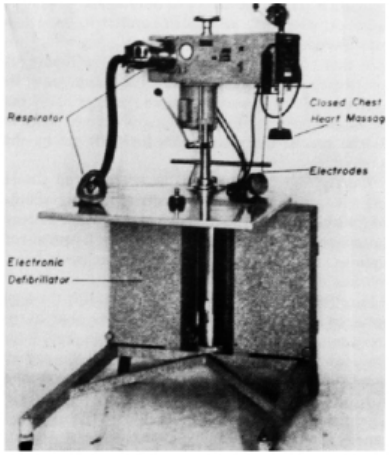


Fig. 5. Beck–Rand electricity powered.

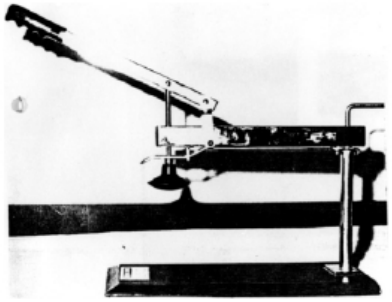


Fig. 11. Hepco Cardiac Massager.

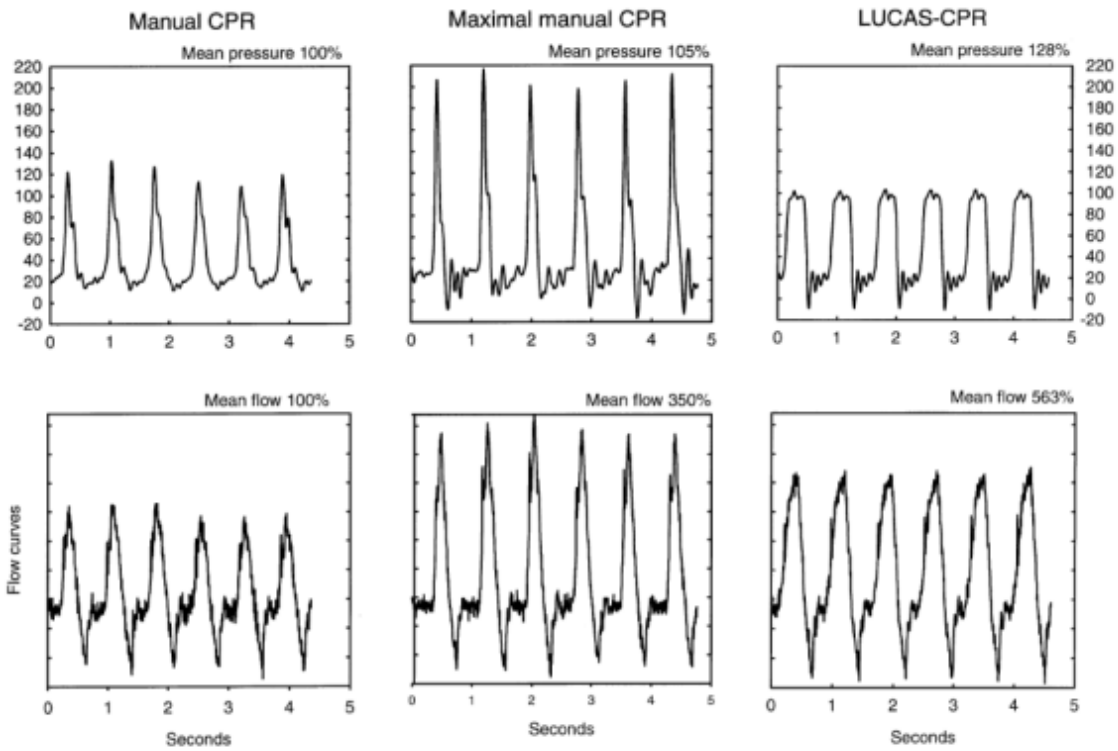
Wik, Resuscitation 2000

CPR: Role of mechanical devices

Acute compression decompression device (ACD) LUCAS II

Load distribution band device AutoPulse

CPR: Role of mechanical devices



Stehen et al., Resuscitation 2002

CPR: Role of mechanical devices

LUCAS II in OHCA-CPR setting

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**

Lancet 2015

Autopulse in OHCA-CPR setting

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]

Resuscitation 2014

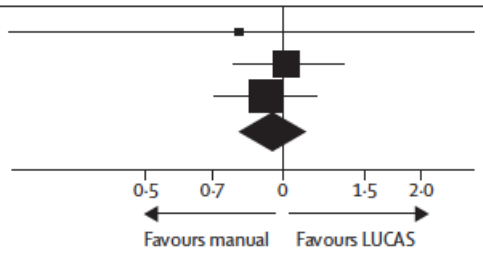
CPR: Role of mechanical devices

A Survival to discharge or 30 days

	LUCAS		Manual			Year	Odds ratio
	Events	Total	Events	Total	Weight		M–H, fixed, 95% CI
Smekal 2011	6	75	7	72	2·7%	2011	0·81 (0·26–2·53)
LINC	112	1286	109	1275	41·6%	2013	1·02 (0·77–1·34)
PARAMEDIC	104	1652	193	2818	55·7%	2014	0·91 (0·71–1·17)
Total (95% CI)		**3013**		**4165**	**100·0%**		**0·96 (0·80–1·15)**
Total events	222		309				

Heterogeneity: χ^2=0·43, df=2 (p=0·81); I^2=0%

Test for overall effect: Z=0·49 (p=0·62)

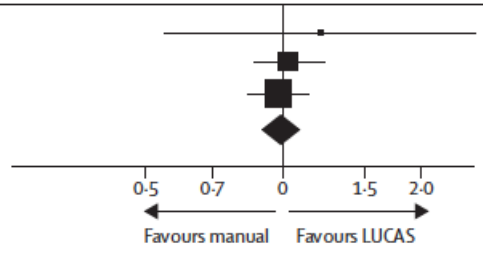


B Survived event

	LUCAS		Manual			Year	Odds ratio
	Events	Total	Events	Total	Weight		M–H, fixed, 95% CI
Smekal 2011	18	75	15	72	1·8%	2011	1·20 (0·55–2·61)
LINC	366	1300	357	1289	40·4%	2013	1·02 (0·86–1·21)
PARAMEDIC	377	1570	658	2690	57·8%	2014	0·98 (0·84–1·13)
Total (95% CI)		**2945**		**4051**	**100·0%**		**1·00 (0·90–1·11)**
Total events	761		1030				

Heterogeneity: χ^2=0·39, df=2 (p=0·82); I^2=0%

Test for overall effect: Z=0·02 (p=0·99)



PARAMEDIC trial: No advantage ACD vs manual chest compresision in survival

Perkins et al. Lancet 2015

CPR: Role of mechanical devices

Table 3
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%)		

[a] Adjusted for covariates and interim analyses.
[b] Secondary outcomes can only be adjusted for the covariates, not the interim analyses.

CIRC trial: No advantage load distribution band vs. manual chest compression in survival

CPR: Role of mechanical devices

Why then thinking about mechanical devices?

Paramedic systems in rural regions with complex logistics/ bridge to advanced therapies

Radiation dose reduction for CPR teams in cath lab settings

Summary

- Use of adrenalin strongly recommended despite lack of outcome data
- Use of capnography strongly recommended to monitor CPR and ROSC
- Use of mechanical devices might be considered

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