Mekanisk brystkompresjon under HLR, er det indisert?

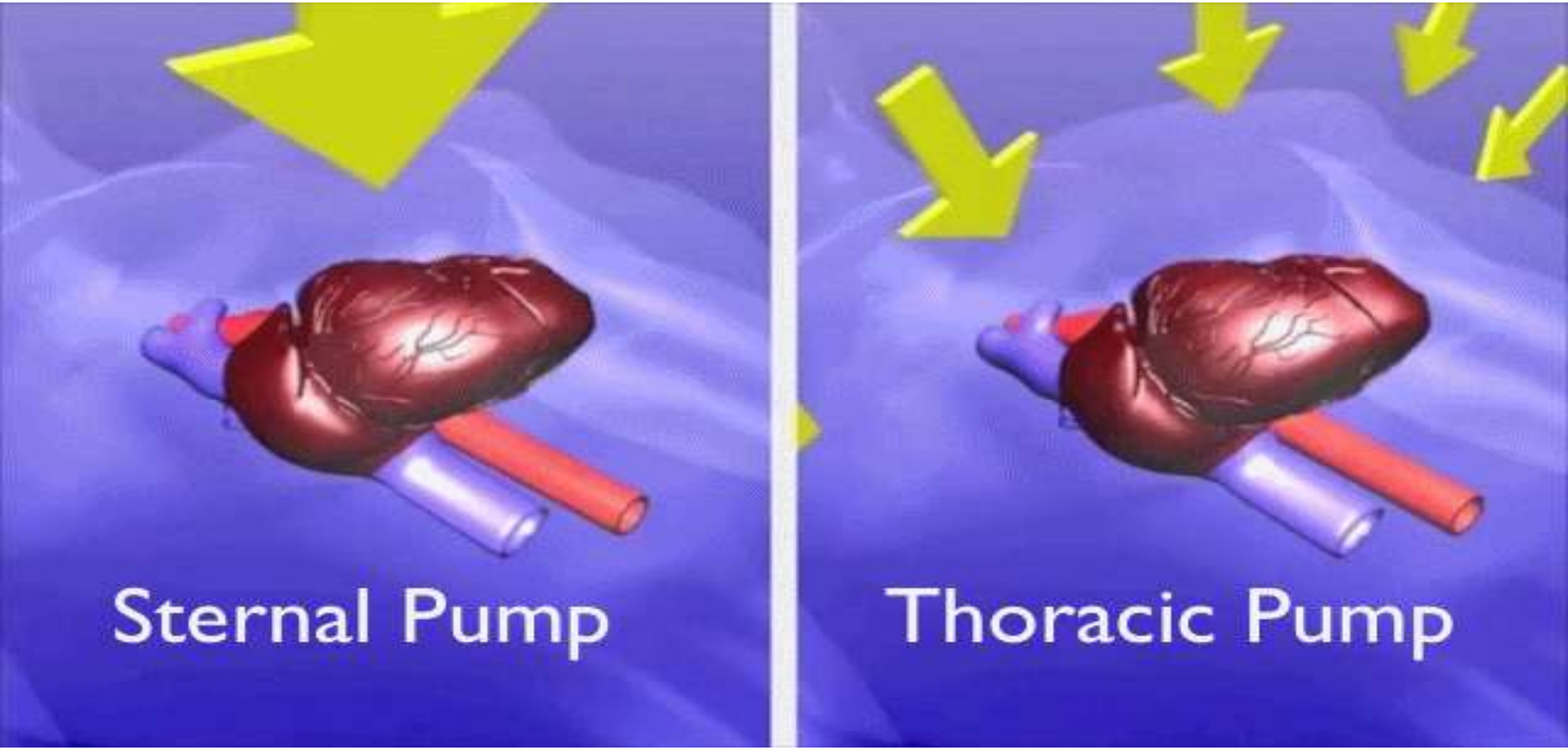
Lars Wik
NAKOS

CI: PI for CIRC som er sponset av Zoll

Manuell brystkompresjon

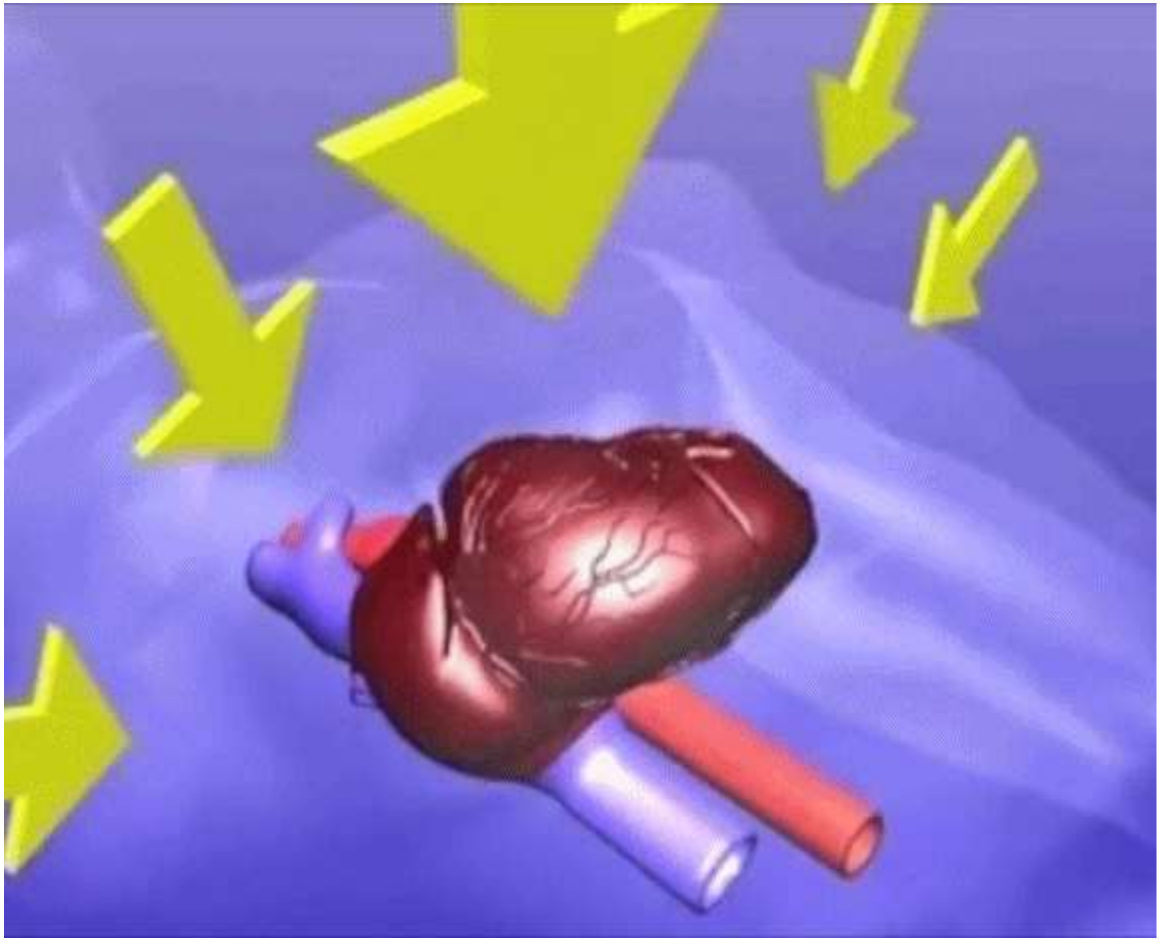
- ”The Gold Standard”
- Guidelines anbefaling 1
- Skal mekanisk brystkompresjon være indisert må den være
  - minst like bra
  - tilføre andre viktige momenter

Theory of Blood Flow



The Sternal Pump is believed to compress only the heart, the Thoracic pump to compress the large vessels and the right atrium.

A Mix of sternal and thoracic pump



Unlike other devices, AutoPulse creates sternal and thoracic compressions

Hvordan utføres ”Gold Standard”?

Prehospital A-CPR quality in three different EMS

(Akershus, Stockholm, London)

	First 5 minutes of CPR *Mean ± SD*	Whole episode of CPR *Mean ± SD*
No Flow Ratio	**0.49 ± 0.21**	**0.48 ± 0.18**
Compressions		
# per minute	60 ± 24	64 ± 23
Rate (c/min)	120 ± 20	121 ± 18
Depth (mm)	35 ± 10	34 ± 9
Compression part of DC	0.41 ± 0.05	0.42 ± 0.04

Wik L et al, JAMA 2005

- same results from Abella et al, Chicago, inhospital arrests, JAMA 2005
  Valenzueala et al, Tucson, prehospital arrests, Circulation 2005

Bad A-CPR quality during a long time before ROSC!

Har kvalitet av ”Gold Standard” noe å si?

Christenson Circulation 2009

Chest Compression Fraction and Survival

No problem during Mechanical Devices

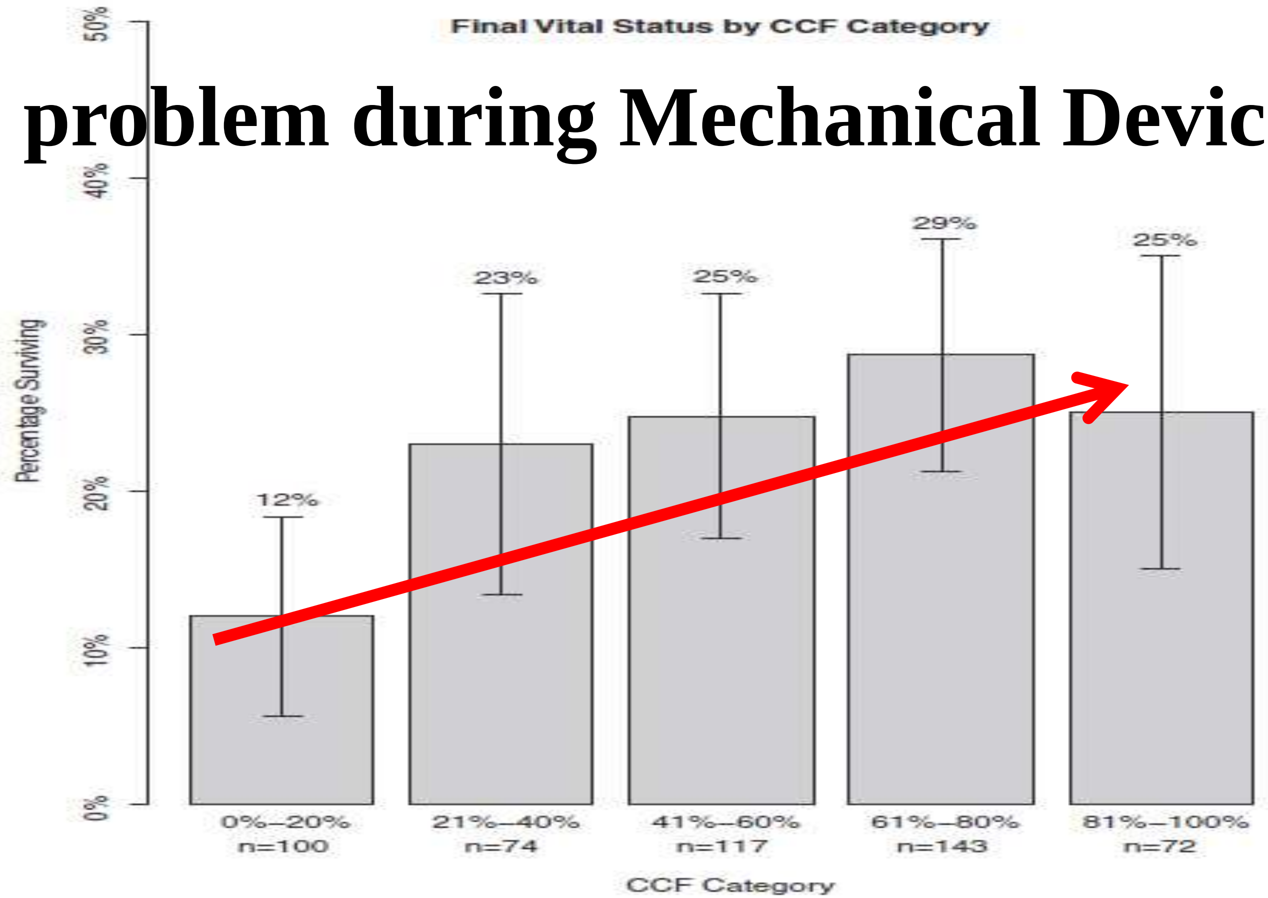
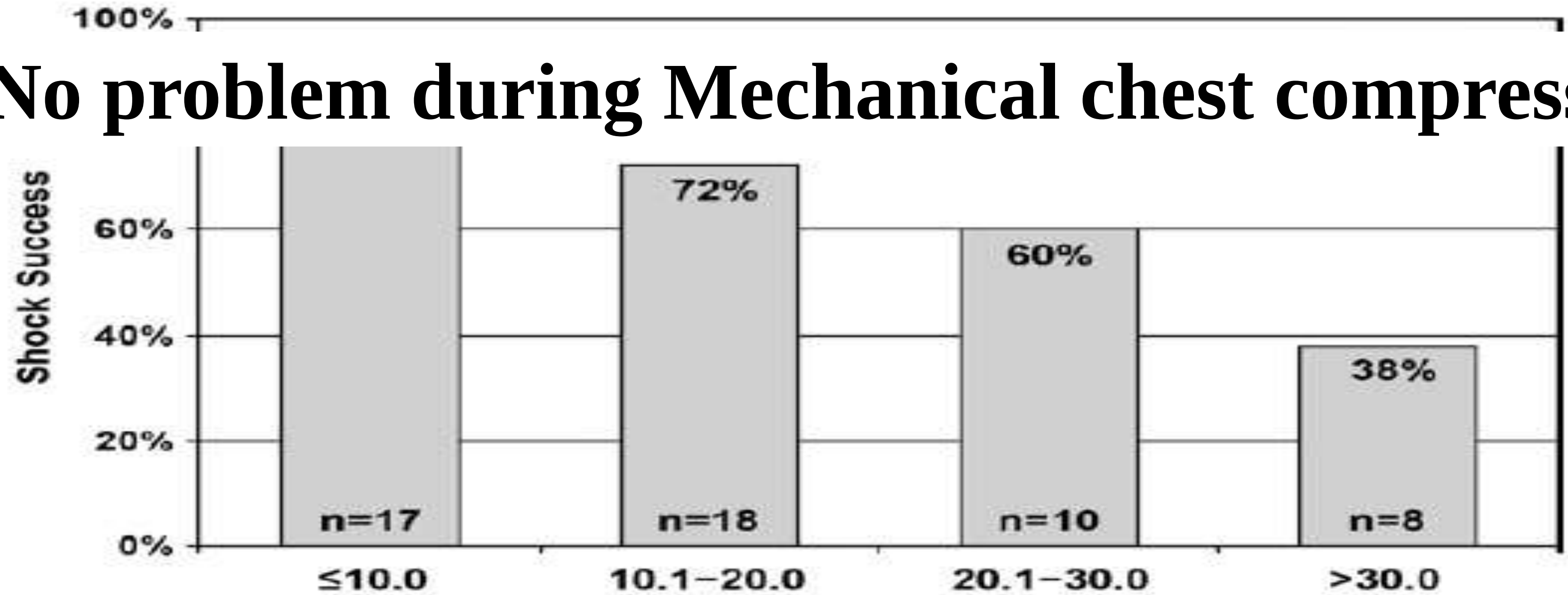


Figure 2. Survival to discharge for each category of chest compression fraction.

Edelson Resuscitation 2008

Preshock Pause

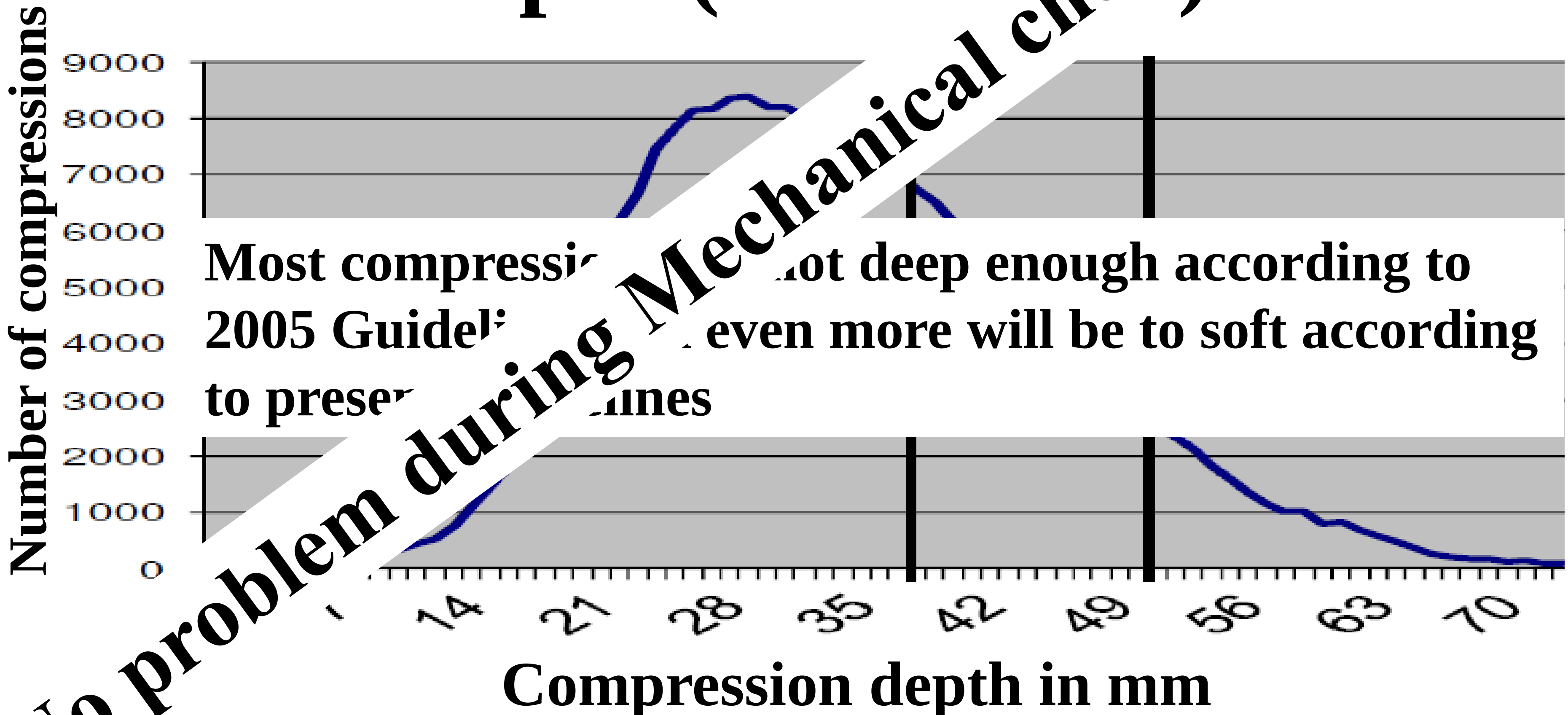
No problem during Mechanical chest compression



Increased pre – shock pauses are significantly associated with a smaller probability of shock success. 68% over 10 sec. Also showed by Sunde K. 1999

Wik et al JAMA 2005

The distribution of Comp ... ions depth (n= 234 ...)

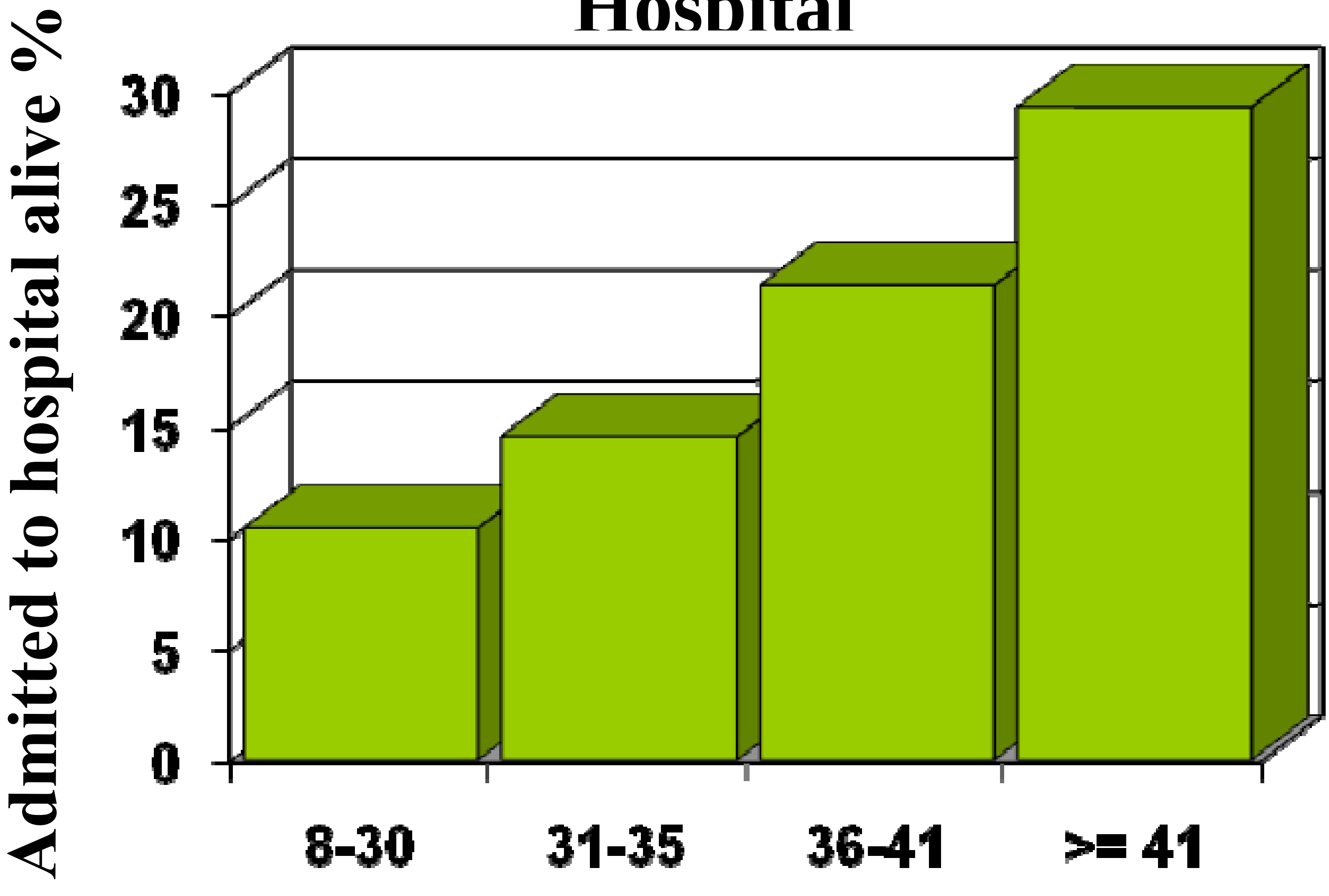


Most compressio ... not deep enough according to 2005 Guideli ... even more will be to soft according to prese ... elines

No problem during Mechanical chest compression

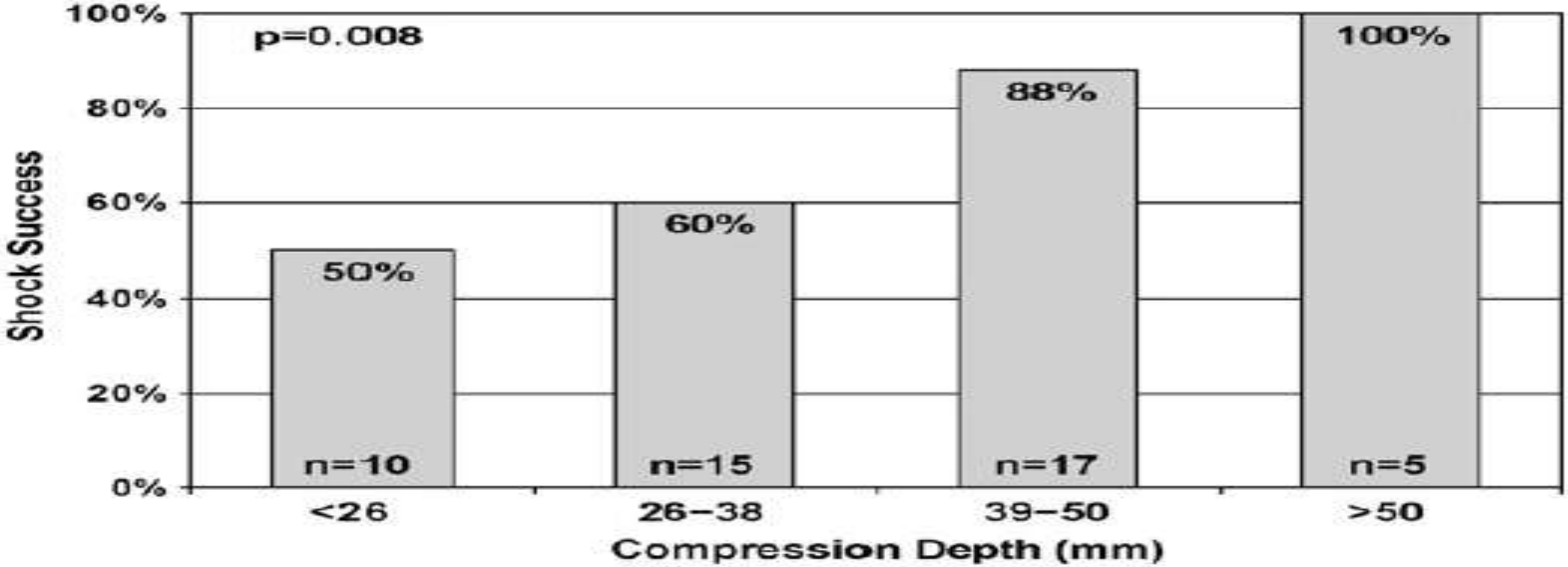
Wik et al JAMA 2005

Compression depth and admittance to Hospital



Edelson **Resuscitation** 2006

Compression Depth and shock success

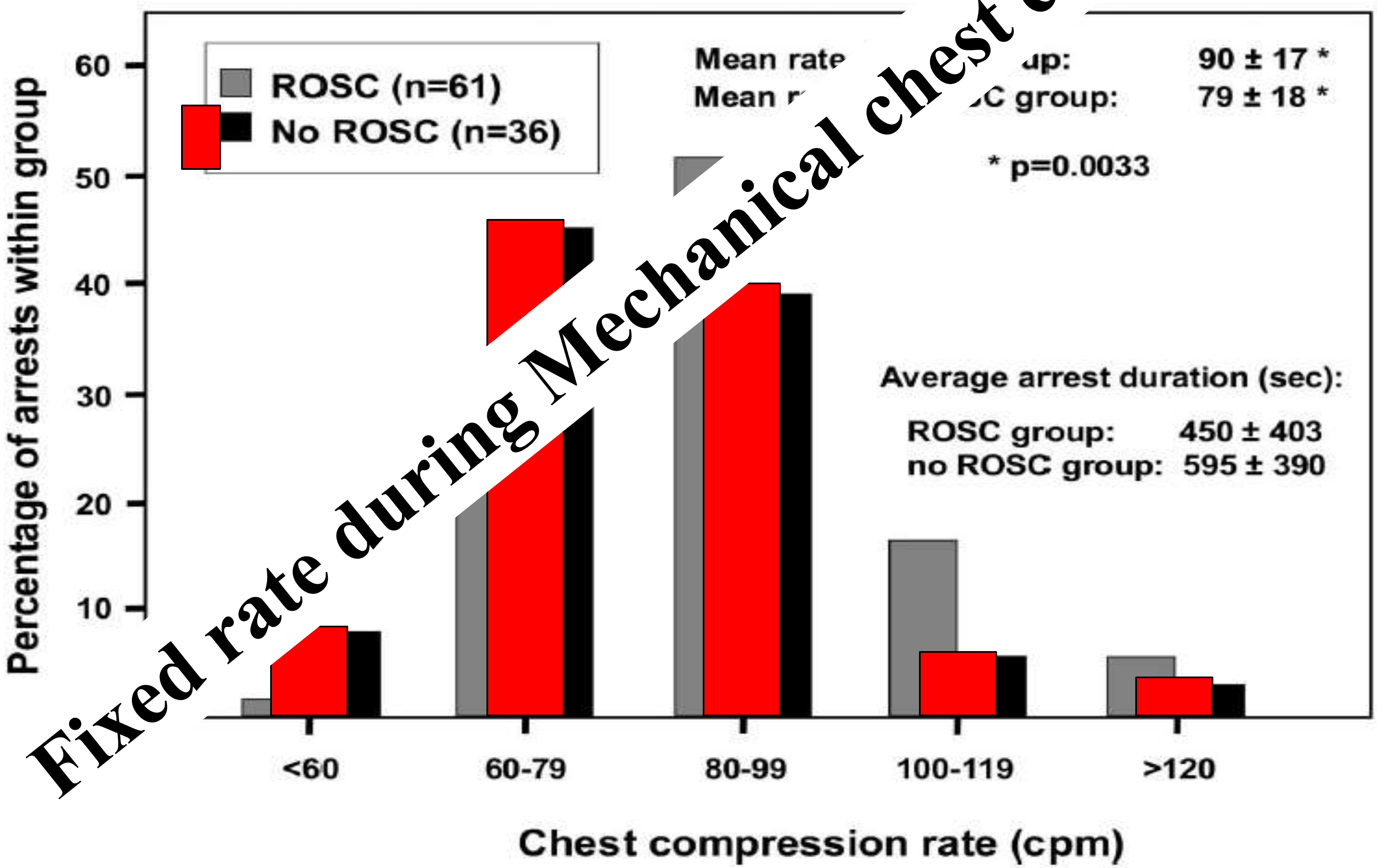


Deeper chest compressions are significantly associated with increased probability of shock success

Abella B et al. Circulation 2005

Chest Compression Rates correla[...]ith initial resuscitation out[...]

Fixed rate during Mechanical chest compression



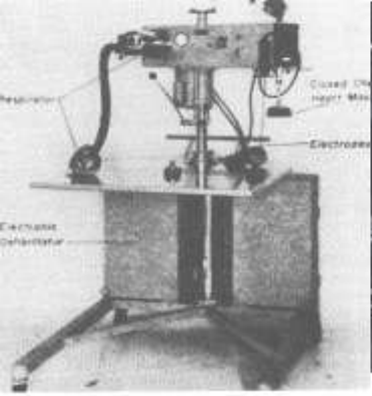


Fig. 5. Beck–Rand electricity powered

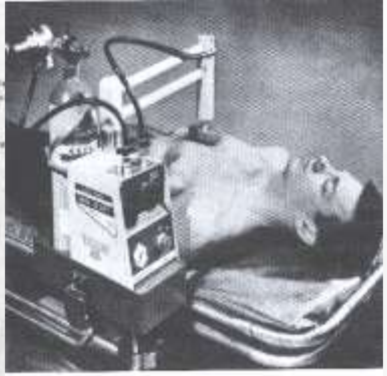
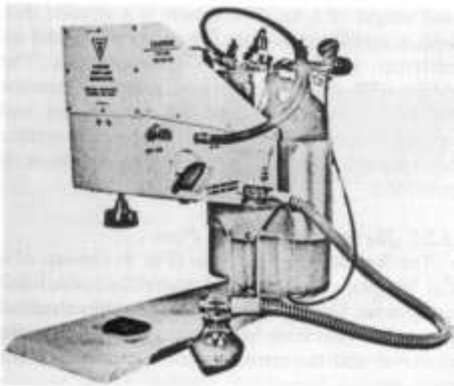
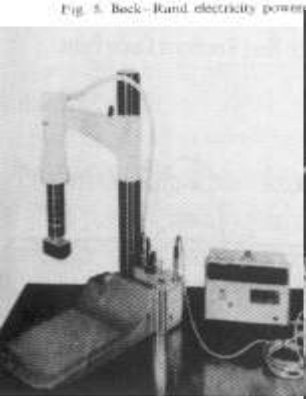
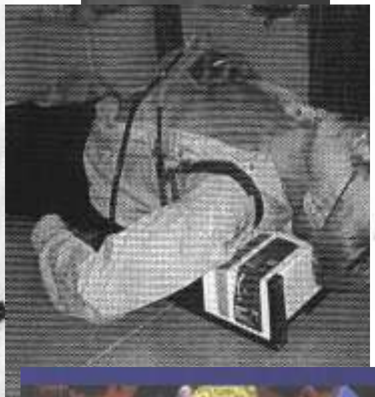


Fig. 4. Iron Heart gas powered.

Fig. 10. Bowen Pulsator.







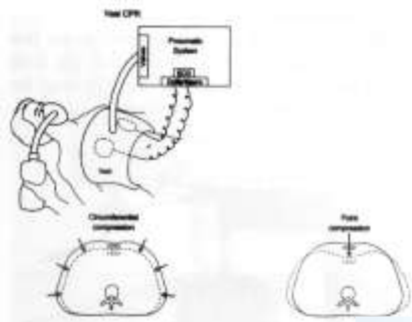


Fig. 6. Vest cardiopulmonary resuscitation gas power

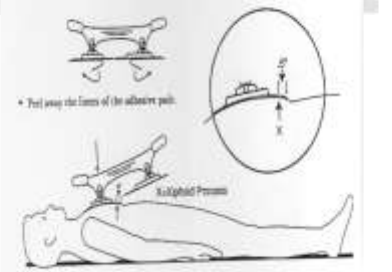


Fig. 12. Lifestick.

Fig. 9. Roarty Cardiac Press

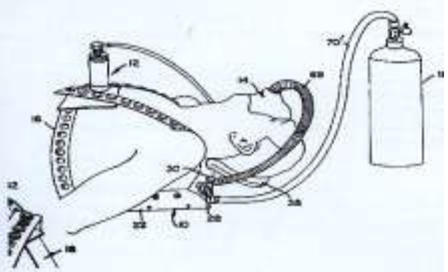


Fig. 2. Travenol/Baxter gas powered.

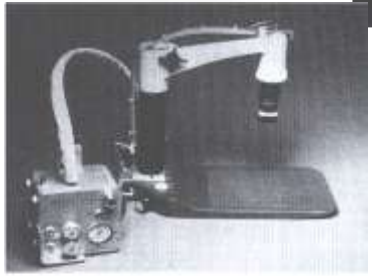


Fig. 1. Thumper gas powered.

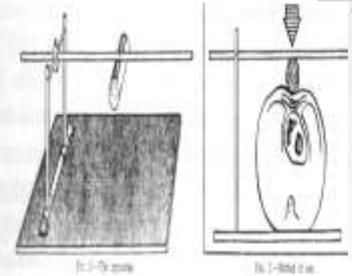
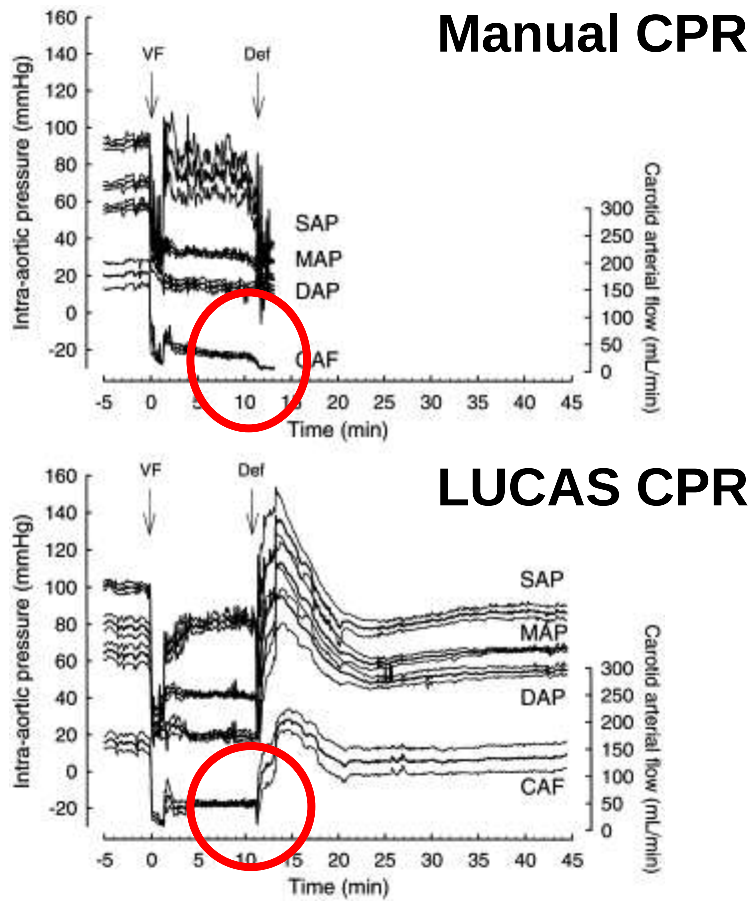


Fig. 11. Hepet Cardiac Massager.

Eksperimentelle studier som viser at mekanisk HLR er indisert

Pressure and Carotid flow curves for gas LUCAS and manual CPR (pig)



ROSC 0

ROSC 5/6

Evaluation of LUCAS, a new device for automatic mechanical compression and active decompression resuscitation Steen S et al. Resuscitation 2002

Cardiopulmonary resuscitation with a novel chest compression device in a Porcine model of Cardiac Arrest.

Halperin HR et al JACC 2004;44:2214-20

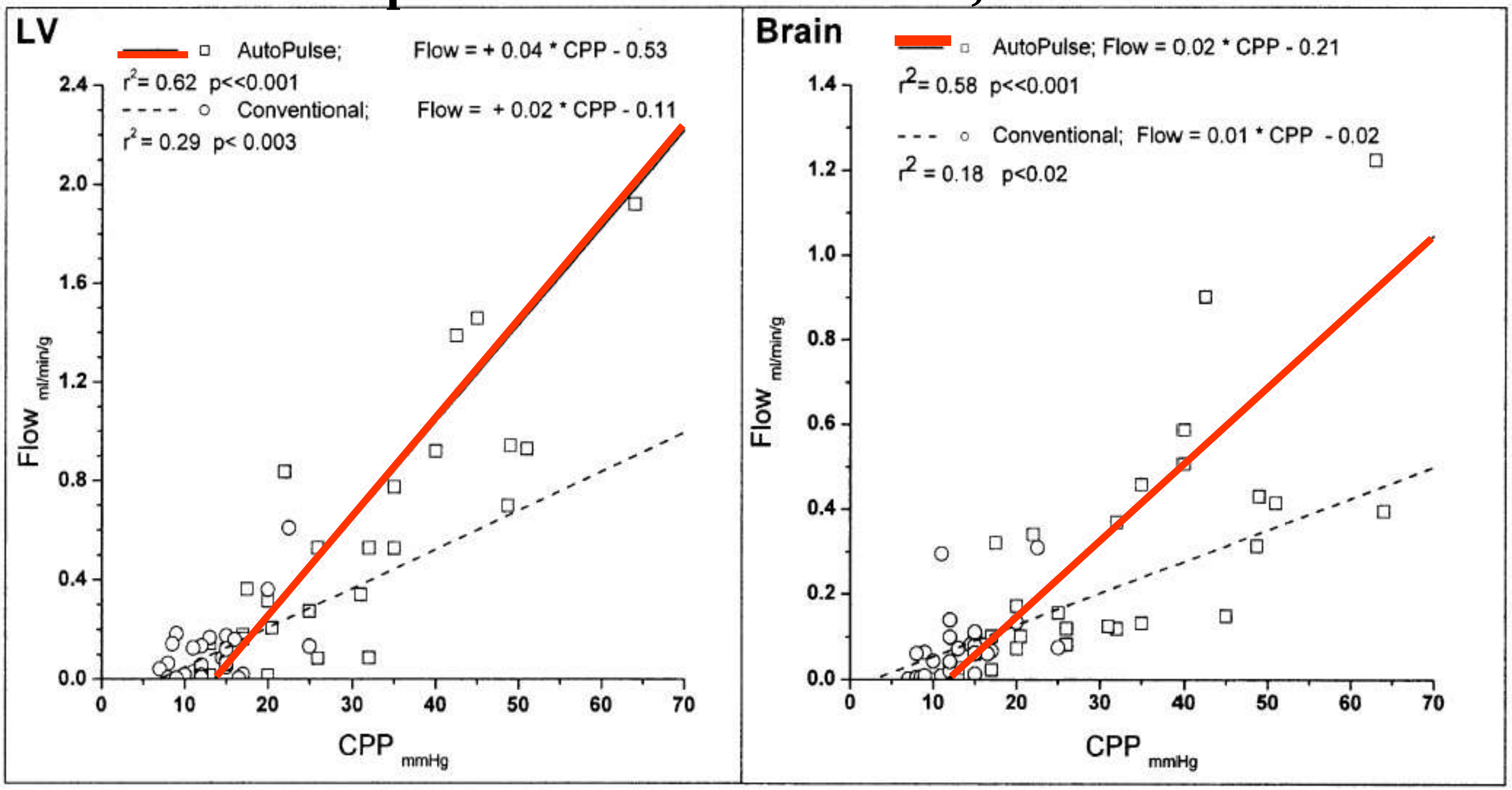
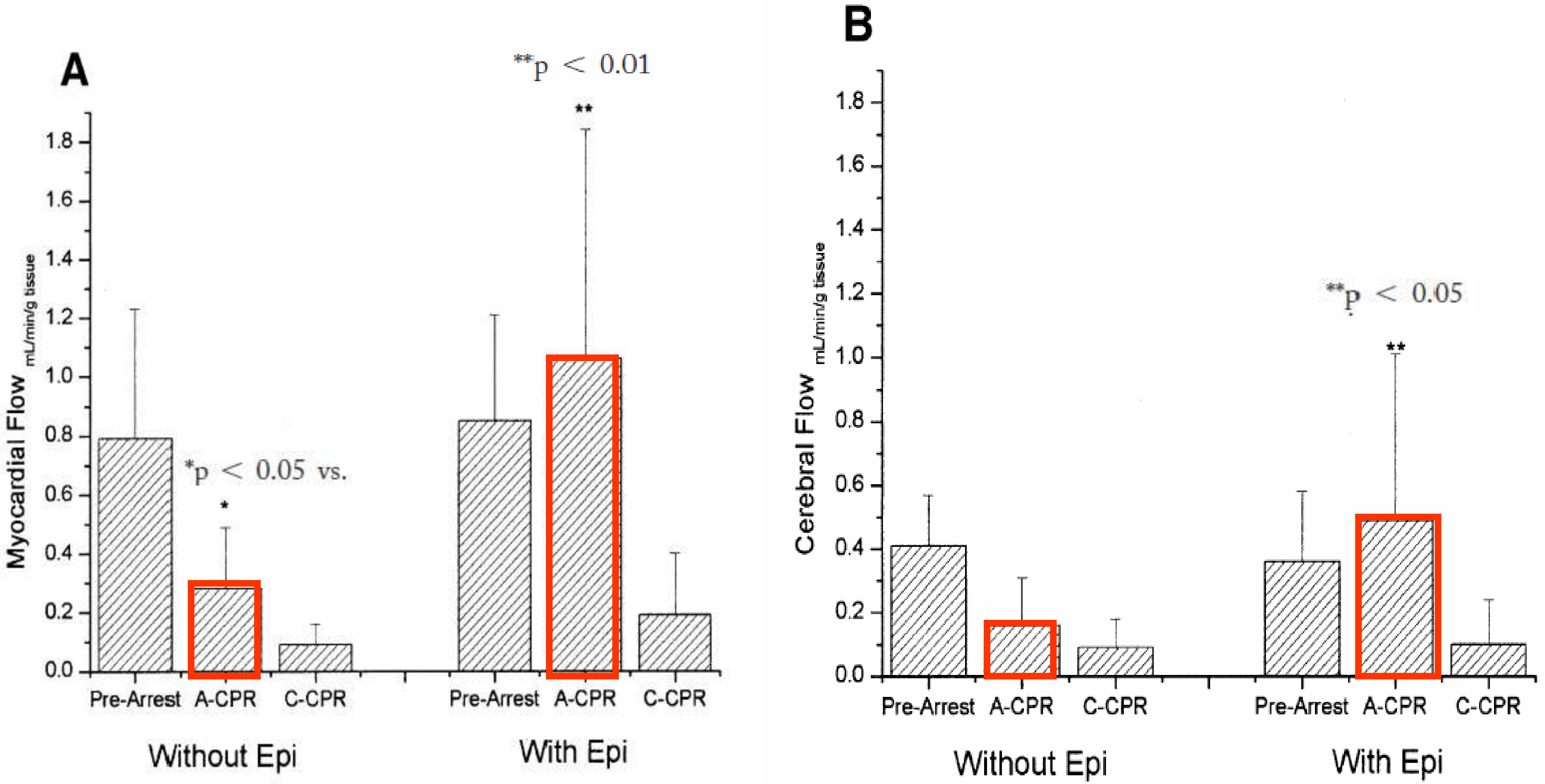


Figure 4. Correlations between left ventricular (LV) and brain flows, and coronary perfusion pressure (CPP), for AutoPulse cardiopulmonary resuscitation (A-CPR) and conventional (piston) cardiopulmonary resuscitation (C-CPR). For both the LV and brain, A-CPR produced more flow at given levels of CPP than C-CPR ($p < 0.05$).

Cardiopulmonary resuscitation with a novel chest compression device in a Porcine model of Cardiac Arrest.

Halperin HR et al JACC 2004;44:2214-20



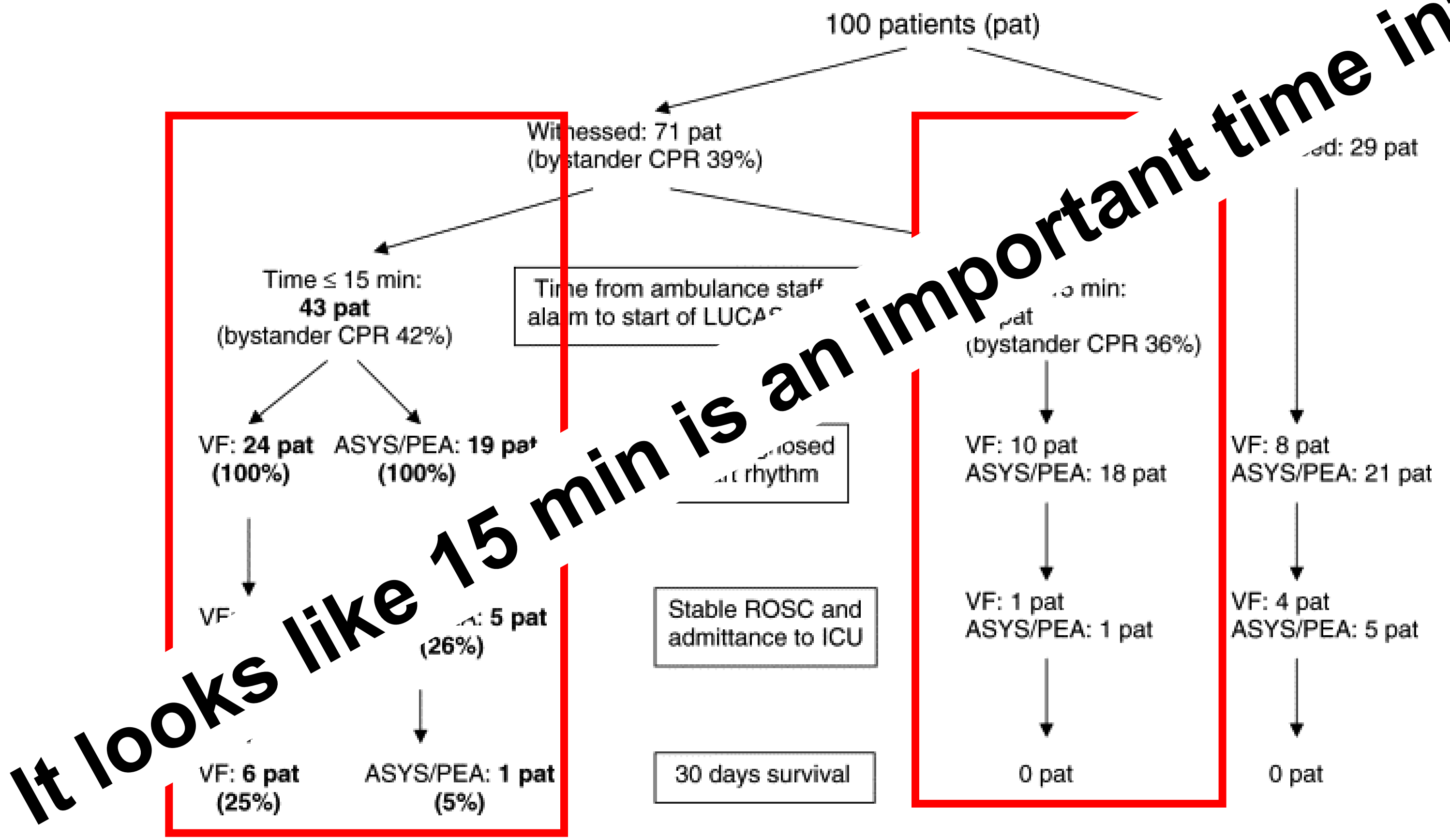
Kliniske studier som viser at mekanisk HLR er indisert

Quality (hands off) of mechanical vs manual chest compressions during CPR

	Entire episode	Before transport	During transport	P value
Manual	0.22 ± 0.09	0.19 ± 0.09	0.27 ± 0.15	0.002
Mechanical	0.09 ± 0.06	0.10 ± 0.06	0.08 ± 0.06	0.248

Olasveengen TM, Wik L, Steen PA. Resuscitation 2007

Treatment of out-of-hospital cardiac arrest with gas LUCAS, a new device for automatic mechanical compression and active decompression resuscitation



Steen S et al. Resuscitation 2005

gas LUCAS In Gothenburg

NO DIFFERENCE, IN SPITE OF THE FACT THAT LUCAS ARRIVED LATE

	LUCAS	**Manual**
ROSC	[illegible]	51 %
Admitted	38 %	37 %
Discharged	8 %	10 %

Cluster randomization
(LUCAS changed between the ALS units)

Axelsson et al. Resuscitation 2006

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

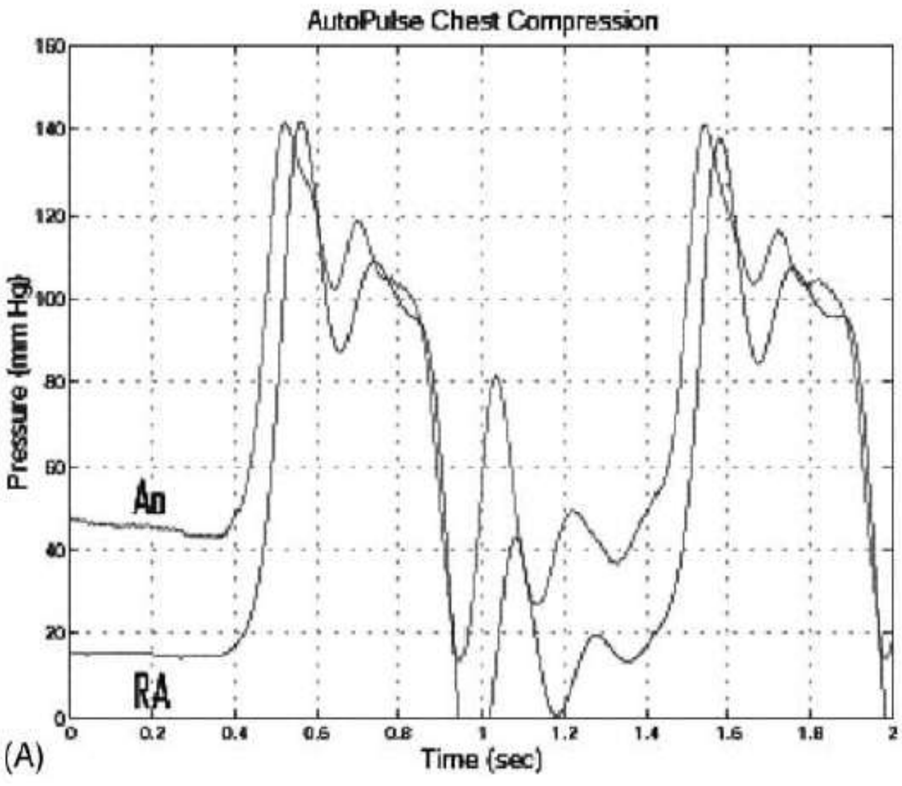
Timerman et al. Resuscitation 2002.

- Included after 10 min with ALS
- Catheters in thoracic aorta and right atrium
- Intubated, epi every 3-5 min
- Switching between manual (100/min) and mechanical (60/min) 90 sec each
- 31 included but only 16 with good data quality

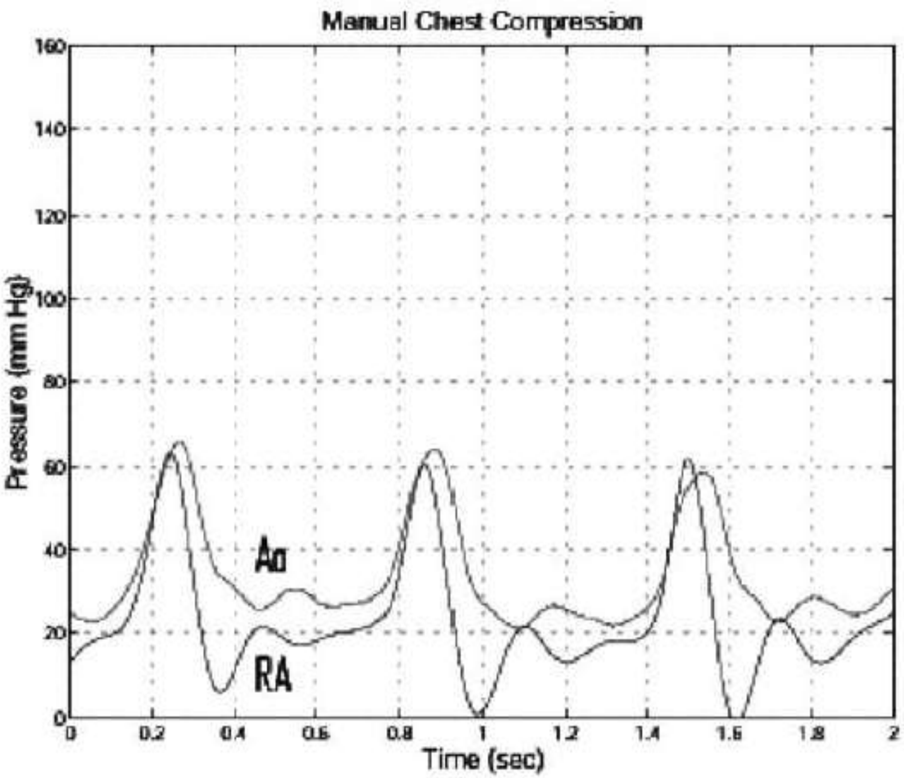
Improved hemodynamics performance with a novel chest compression device during treatment of in-hospital cardiac arrest.

Timmerman S et al. Resuscitation 2004;61:273-80

AutoPulse Chest Compressions



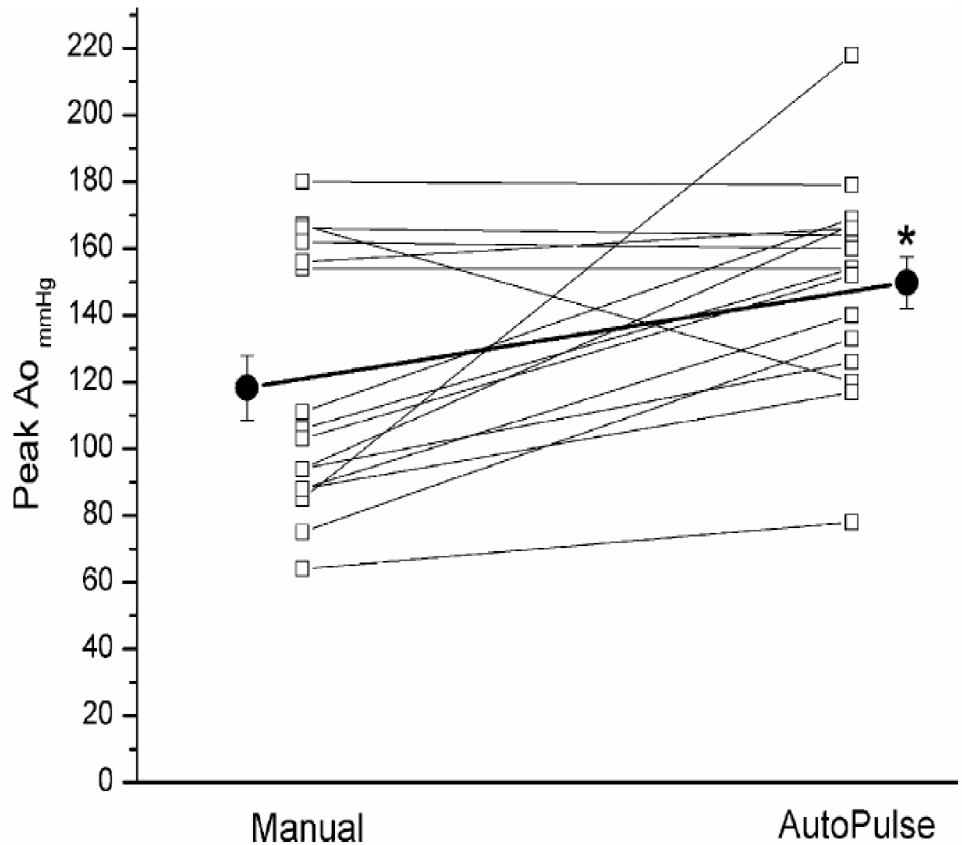
Manual Chest Compressions



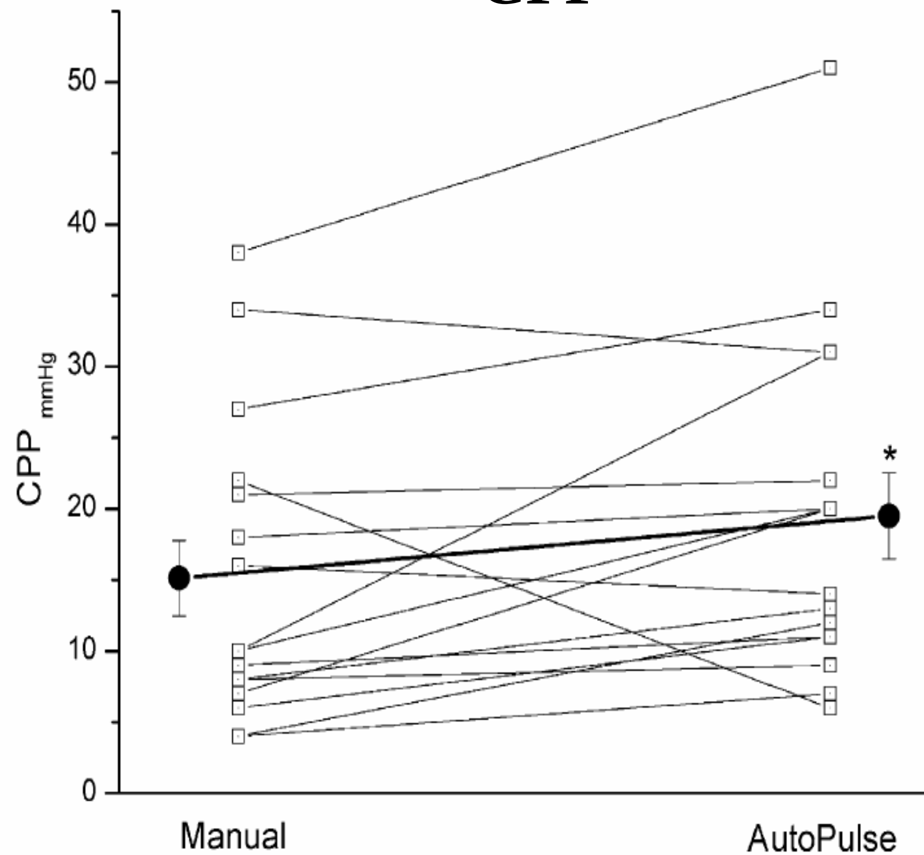
Improved hemodynamics performance with a novel chest compression device during treatment of in-hospital cardiac arrest.

Timmerman S et al. Resuscitation 2004;61:273-80

Peak Ao



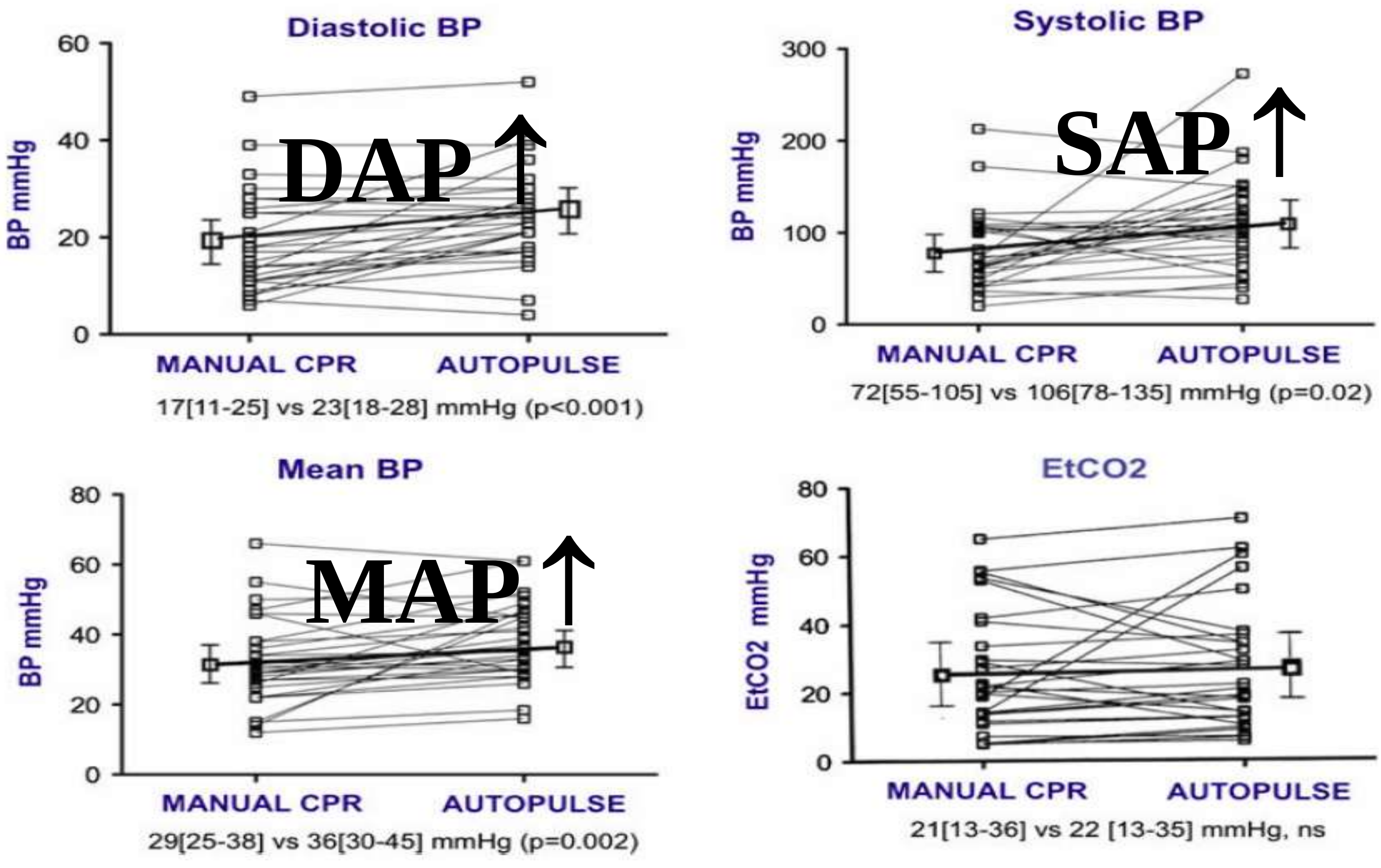
CPP



(* $P < 0.015$).

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

Duchateau FX et al. Int Care Med 2010;36:1256-1260



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

	ROSC	Not ROSC	Tot	P value
M CPR	27 29%	66	93	0.003
A CPR	27 39%	44	69	
M CPR asystoli	11 22%	38	49	0.008
A CPR asystoli	13 37%	22	35	
M CPR PEA	5 23%	17	22	0.079
A CPR PEA	6 38%	10	16	
M CPR VF	11 50%	11	22	0.340
A CPR VF	8 44%	10	18	

Historical control

Casner et al. Prehosp Emerg Care 2005

Effect of a CPR assist device on survival to Emergency Department arrival in out of hospital cardiac arrest.

	AutoPulse N=118	Manual N=405	OR	CI 95%	p
Survival to ER	29%	19%	1.7	1.1-2.8	0.02
VF	31%	33%	0.9	0.4-2.1	0.85
PEA	32%	17%	2.4	1.1-5.5	0.04
Asystoli	24%	10%	2.8	1.2-6.3	0.01

Not randomized

Swanson M et al. Circulation 2005

Use of an automated, load-distributing band chest compression device for out-of-hospital cardiac arrest resuscitation (case-control, CPR first)

	AutoPulse N=284	Manual N=499	P
ROSC	35%	20%	0.0001
Admitted Hospital	21%	11%	0.0002
Survival	10%	3%	0.0001
EMS witnessed	19%	13%	

Ong et al. JAMA 2006

CPR interuptions with use of a Load Distributing Band (LDB) device during ED cardiac arrest.

Ong ME et al. Ann Emerg Med 2010

	Manual CPR N=26	LDB CPR N=41
No flow time (mean)(IQR) First 5 min	85s (45-112s)	104s (69-151)
No flow ratio (mean) First 5 min	0.28	0.40
No flow time (mean)(IQR) 5-10 min	85s (59-151)	52s (34-82)
No flow ratio (mean) 5-10 min	0.34	0.21

Average deployement time 152s.

Case reports
Spesielle situasjoner (ref prof Sunde)

Cardiac arrest and resuscitation with an automatic mechanical chest compression device (LUCAS) due to anaphylaxis of a woman receiving caesarean section because of pre-eclampsia

A case report

Tor Thomas Vatsgar, Ola Ingebrigtsen, Lars Olav Fjose, Bente Wikstrøm, Jan Erik Nilsen, Lars Wik

Case report

Use of an automatic mechanical chest compression device (LUCAS) as a bridge to establishing cardiopulmonary bypass for a patient with hypothermic cardiac arrest

Lars Wik, Steinar Kiil

Resuscitation 2005.

Continuous Mechanical Chest Compressions During Cardiac Arrest to Facilitate Restoration of Coronary Circulation With Percutaneous Coronary Intervention

Use of an Automated Device for External Chest Compressions by First-aid Workers Unfamiliar With the Device: A Step Toward Public Access?

Frédéric Lapostolle, MD, PhD, Jean Marc Agostinucci, MD, Philippe Bertrand, MD, Jean Catineau, MD, Carine Chassery, MD, Mathieu Kessler, Michel Galinski, MD, and Frédéric Adnet, MD, PhD

BRIEF REPORT

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

RESUSCITATION, PROLONGED CARDIAC ARREST, AND AN AUTOMATED

Only one study do not support use of a Mechanical Chest Compression Device

Successf... death us... device d...

Junya Mor... Yuichi Oht...

J.-C. Schewe, U. Heister, A. Hoeft, H. Krep

Klinik und Poliklinik für Anästhesiologie und Operative Intensivmedizin, Universitätsklinikum, Rheinische Friedrich-Wilhelms-Universität, Bonn

Amt für Feuerwehr und Rettungsdienst der Bundesstadt Bonn, Bonn

Klinik für Anästhesiologie und Operative Intensivmedizin, Klinikum der Universität zu Köln, Köln

Out-of-hospital cardiopulmonary resuscitation with the AutoPulse™ system: A prospective observational study with a new load-distributing band chest compression device

Henning Krep, Mathias Mamier, Martin Breil, Ulrich Heister, Matthias Fischer, Andreas Hoeft

Notarzt und AutoPulse – ein gutes Duo im Rettungsdienst?

Fallbeispiel und Erfahrungsbericht

Augmentation of tissue perfusion by a novel compression device increases neurologically intact survival in a porcine model of prolong... cardiac arrest

Fumiaki Ikeno, Hideaki Kaneda, Yoichiro Hongo, Yuji Sakanou..., Christine Nolasco, Sascha Emami, Jennifer Lyons, Mehrdad Reza...

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

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

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, Luis Francisco Cardoso, Jose A.F. Ramires, Henry Halperin

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

Hallstrom AP et al. JAMA 2006

- Randomized (Cluster)
- 3 different protocols, one site changed protocol during the study
- Primary endpoint survival 4h
- AutoPulse n=554, Manual n=517

Results

	AutoPulse	Manual	P
4 h survival	29%	30%	0.74
Discharged	6%	10%	0.04
Asystole			
4h survial	17%	10%	0.099
Survival	2%	0%	ns
VF/VT + PEA			
4h survival	34%	35%	1.0
Survival	10%	17%	0.099

The Circulation Improving Resuscitation Care (CIRC) Trial:

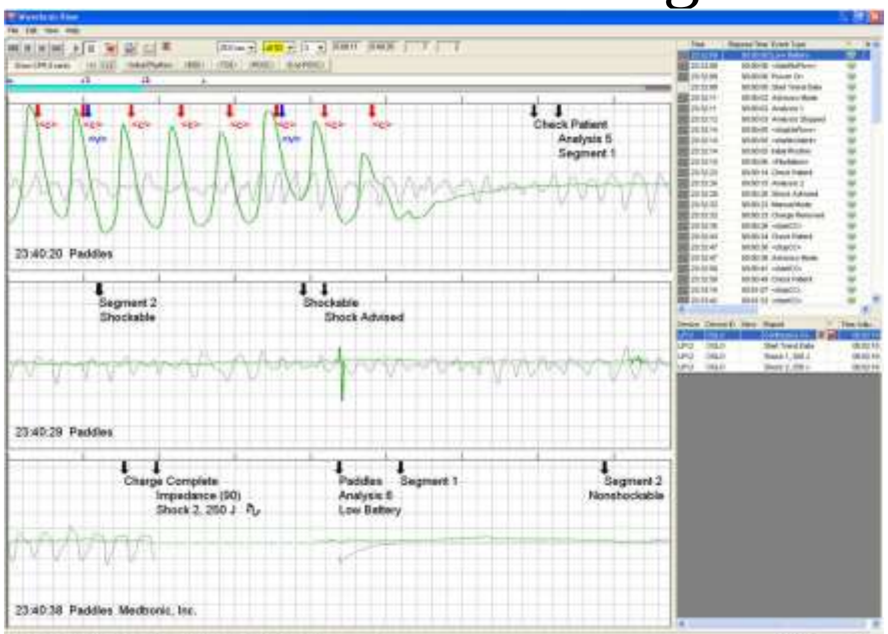
1. Operate AutoPulse and CPR first algorithm

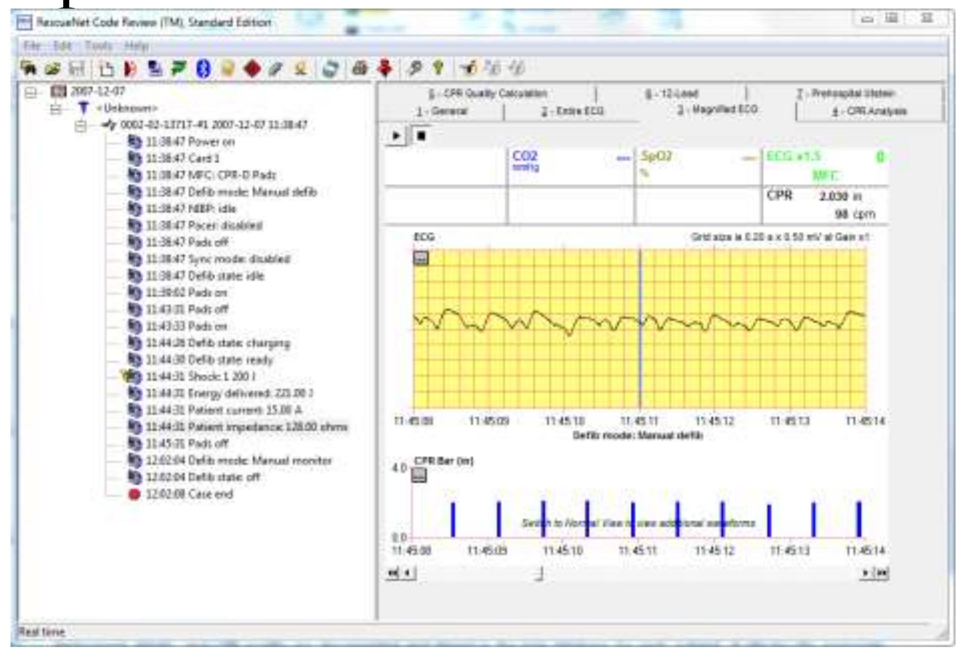
Minimize Hands-Off Time

- Standardized Training
  - 4 hours
    - Train and practice Pit crew deployment strategy
    - Review study protocol
    - Review CPR process

2. Monitor CPR Quality

- CPR process is monitored
  - Transthoracic impedance data (TTI)
  - Accelerometer data. (AD)
  - Basis of moving to next phase





Ad modem Olsen JÅ et al Resuscitation

3. Verify Protocol Adherence

- Formal simulation (manikin) study conducted*
- Evaluated protocol compliance and quality of CPR (TTI, AD)
- Used to guide refresher training curriculum

*Tømte Ø et al Resuscitation

4. Minimize Hawthorne Effect and Other ...s

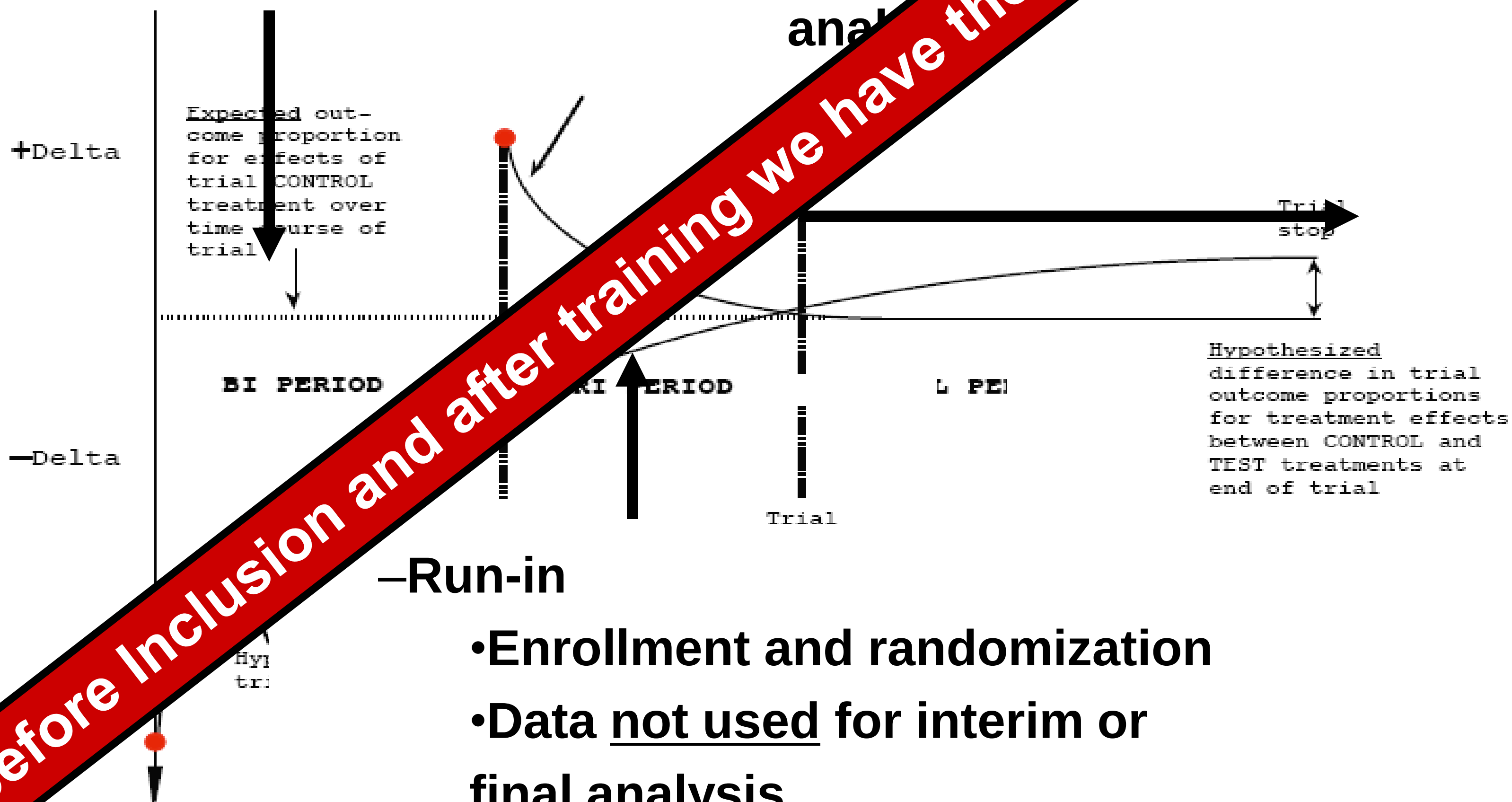
–In-field training

•No enrollment - all pat get AutoPulse

–Statistical inclusi...

•Enrollment ... andomization

•Data u... interim or final ana...



–Run-in

•Enrollment and randomization

•Data <u>not used</u> for interim or final analysis

BUT, before Inclusion and after training we have the CIRC Manikin Study

5. Randomization
Reduce Selection Bias

- Randomization at the subject level
- After decision to resuscitate has been made

6. Sufficiently Powered

- Group Sequential Double Triangular Test
- Powered to determine superiority, inferiority, or true equivalence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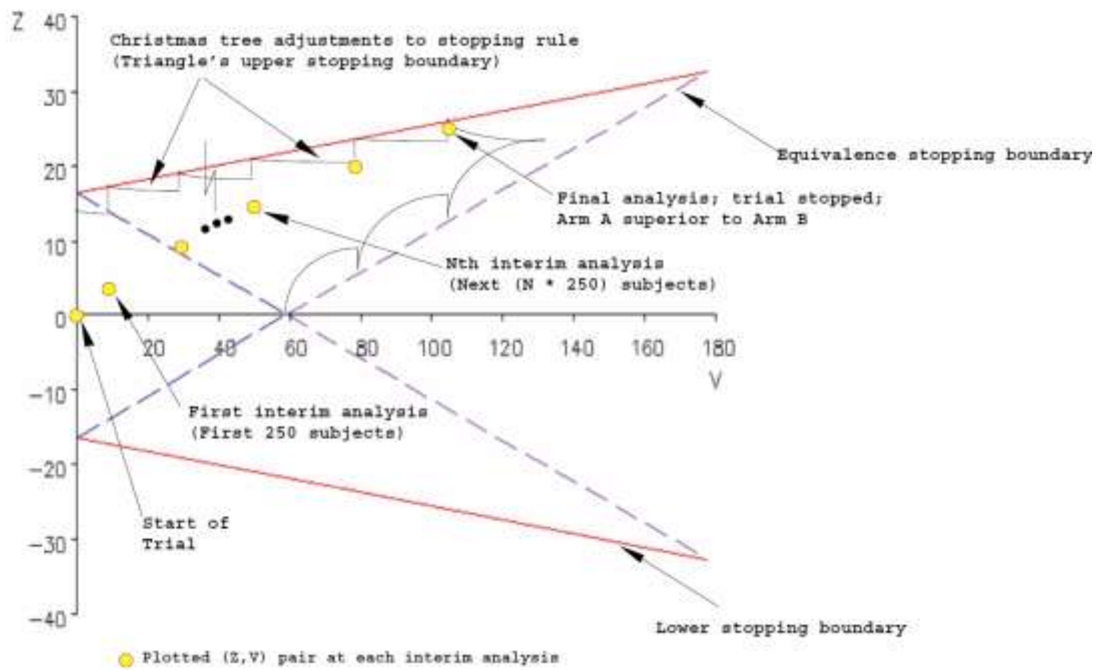
PROPHYLACTIC IMPLANTATION OF A DEFIBRILLATOR IN PATIENTS WITH MYOCARDIAL INFARCTION AND REDUCED EJECTION FRACTION

ARTHUR J. MOSS, M.D., WOJCIECH ZAREBA, M.D., PH.D., W. JACKSON HALL, PH.D., HELMUT KLEIN, M.D., DAVID J. WILBER, M.D., DAVID S. CANNOM, M.D., JAMES P. DAUBERT, M.D., STEVEN L. HIGGINS, M.D., MARY W. BROWN, M.S., AND MARK L. ANDREWS, B.B.S., FOR THE MULTICENTER AUTOMATIC DEFIBRILLATOR IMPLANTATION TRIAL II INVESTIGATORS*



Result CIRC Trial
Survival to Hospital Discharge

Integrated AutoPulse CPR

Manual CPR

Wik L et al 2011

KONKLUSJON

- Ja
- Spesielle situasjoner
- Foreløpig er bare AutoPulse dokumentert vitenskapelig i en randomisert studie