Con il patrocinio di

REGIONE LIGURIA

IRC Italian Resuscitation Council

CONGRESSO NAZIONALE IRC 2017

13 · 14 OTTOBRE

DALL'EVIDENZA **AI TRATTAMENTI FUTURI**

CENTRO CONGRESSI MAGAZZINI DEL COTONE

PORTO ANTICO GENOVA

FISIOPATOLOGIA DELLA RIANIMAZIONE CARDIOPOLMONARE

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IRCCS Istituto di Ricerche Farmacologiche Mario Negri, Dipartimento di Fisiopatologia Cardiopolmonare, Milano, IT

IRC-Young, Italian Resuscitation Council, Bologna, Italia

UNIVERSITÀ DEGLI STUDI DI MILANO

ISTITUTO DI RICERCHE FARMACOLOGICHE MARIO NEGRI IRCCS

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13 E 14 OTTOBRE
CENTRO CONGRESSI MAGAZZINI DEL COTONE
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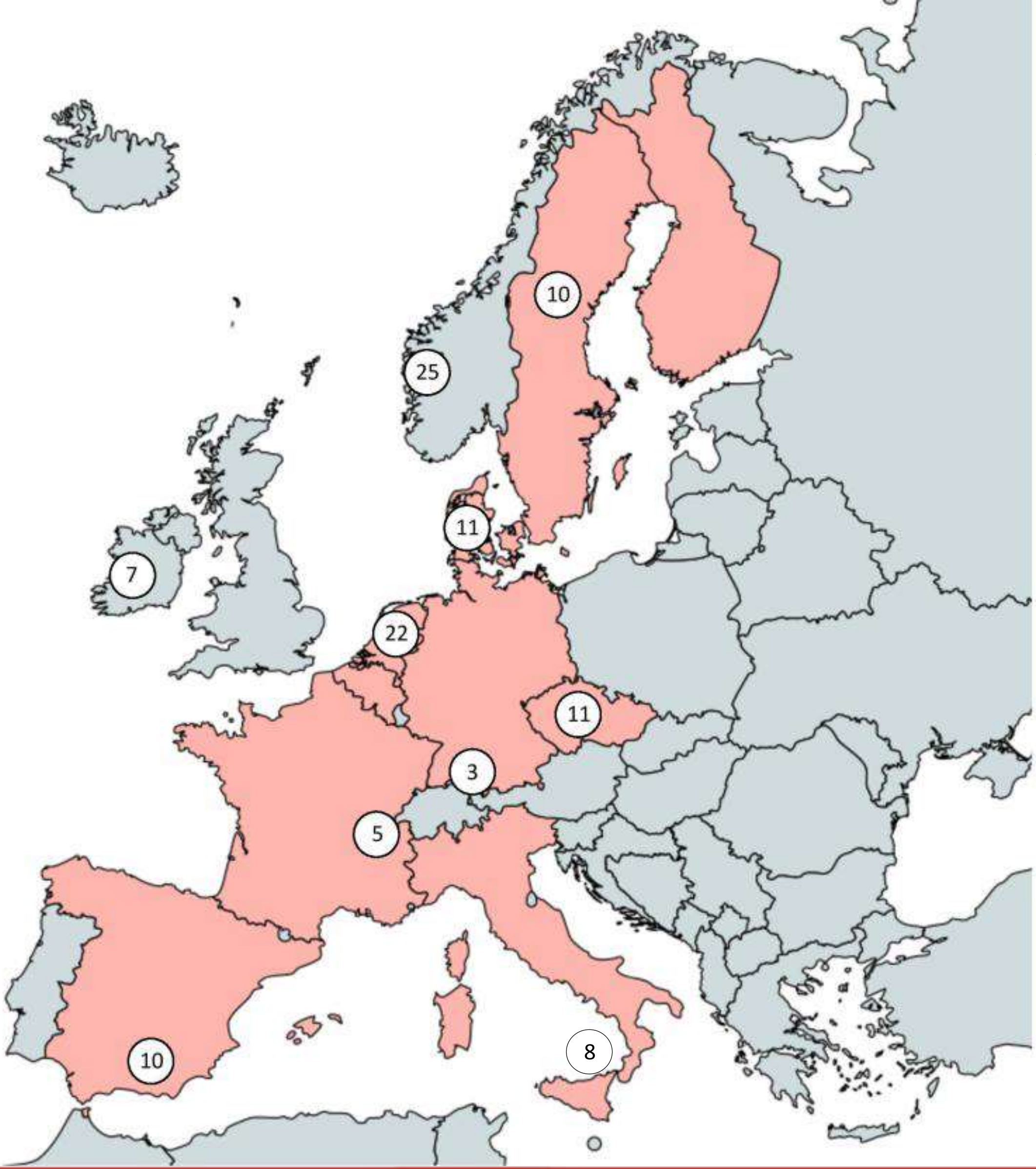
Eventi anno:

400.000 USA

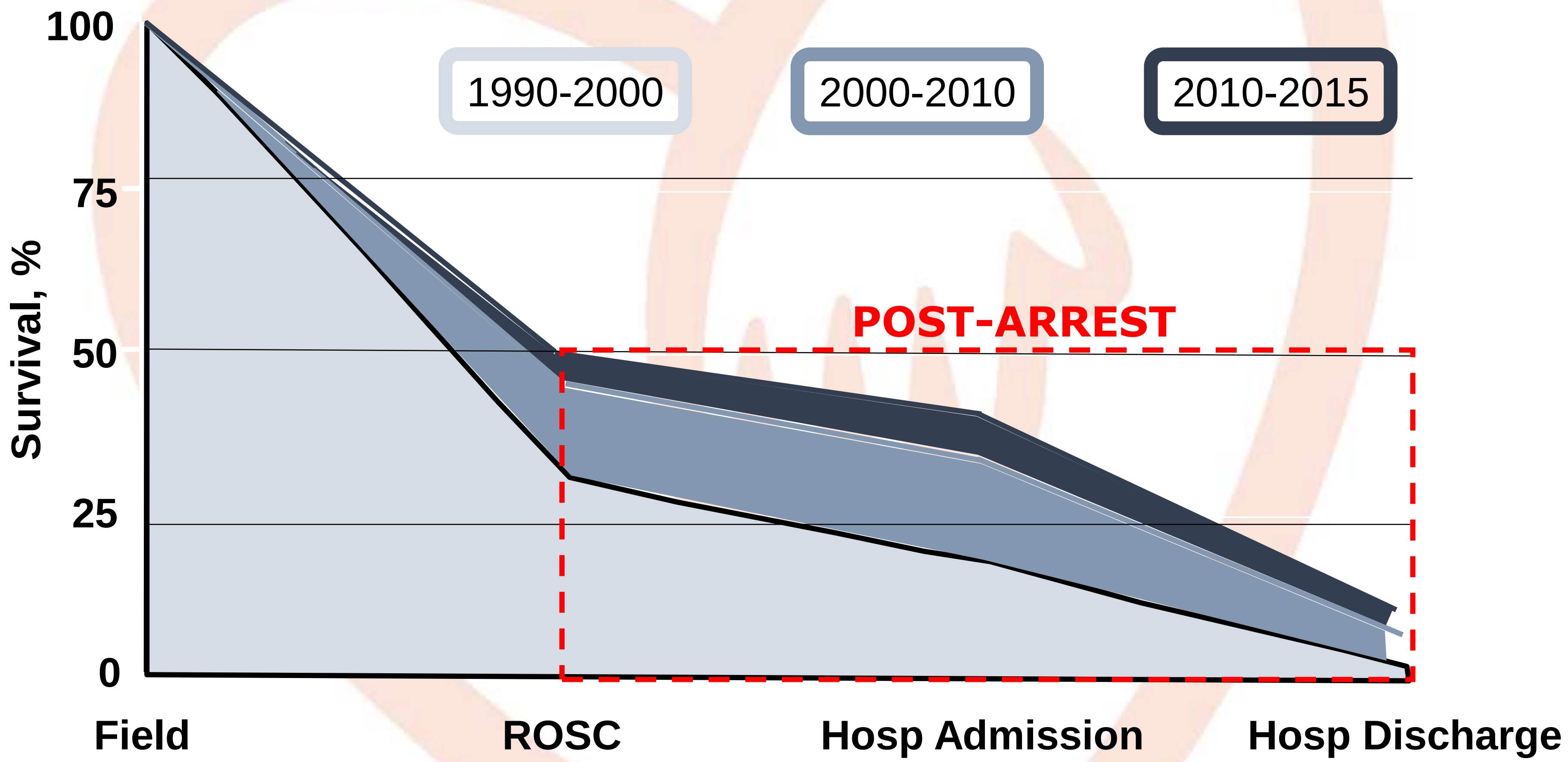
700.000 Europa

70.000 Italia

Survival after cardiac arrest in Europe



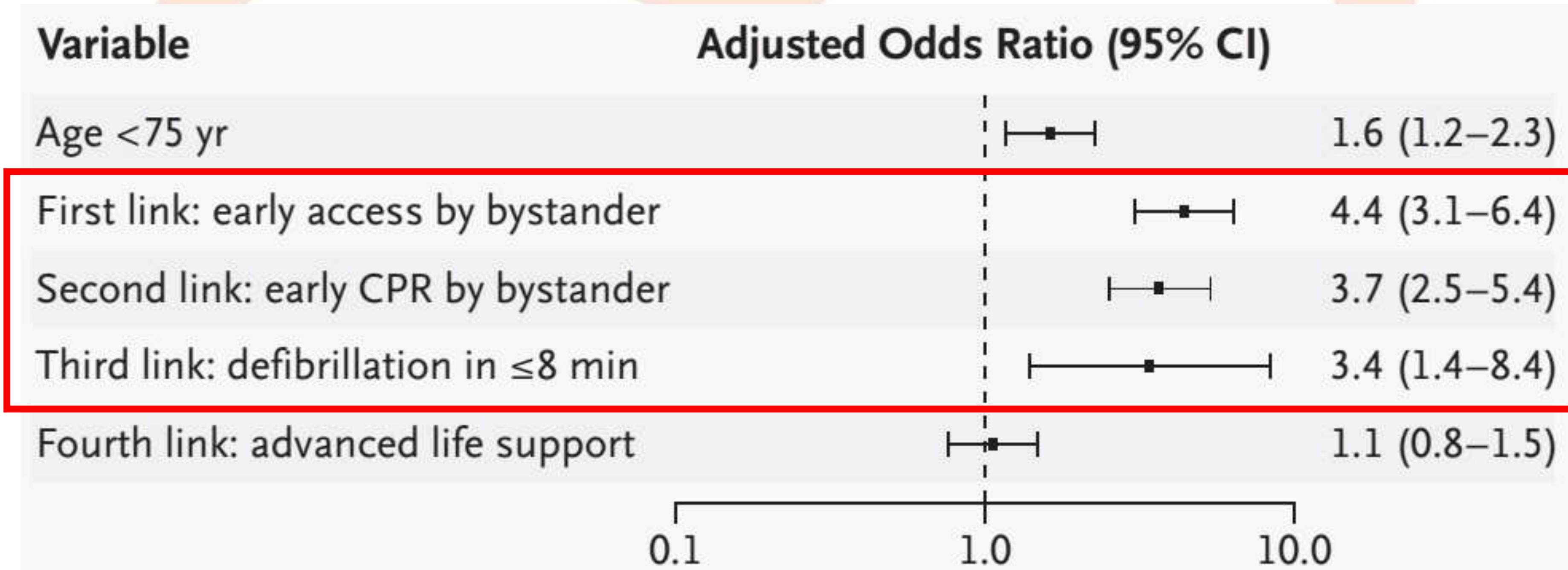
SURVIVAL IN CARDIAC ARREST PATIENTS



CATENA DELLA SOPRAVVIVENZA

Nolan JP et al. Resuscitation 2010
Monsieurs KG et al. Resuscitation 2015

CATENA DELLA SOPRAVVIVENZA E SOPRAVVIVENZA



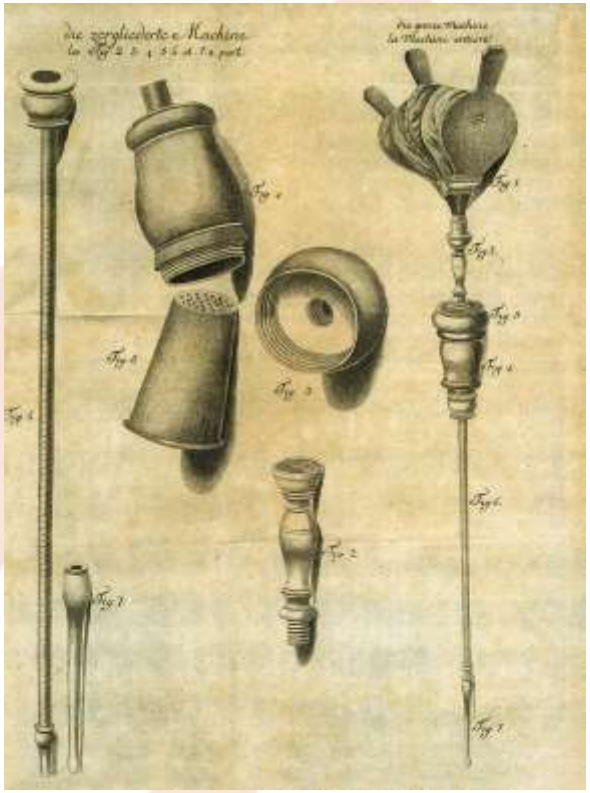
Stiell et al. NEJM 2004


FUTURE
PAST
PRESENT

1500

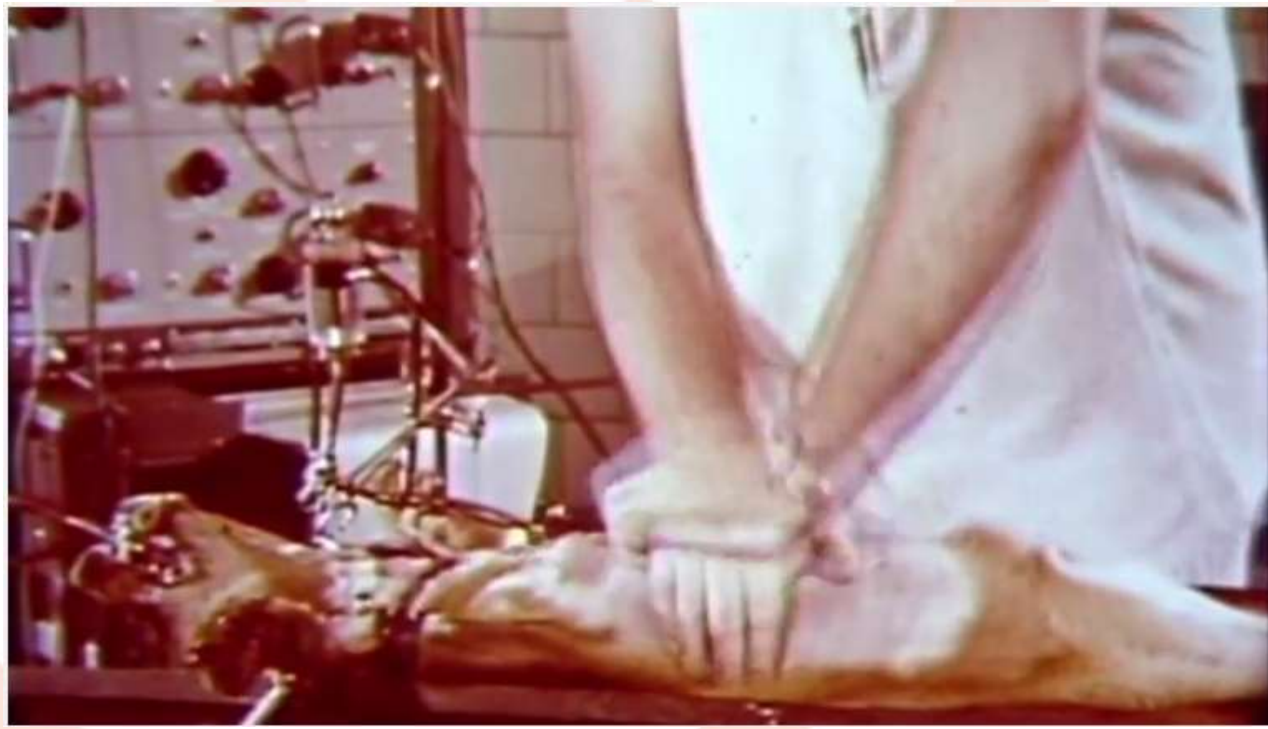
1700

Tobacco smoke enema

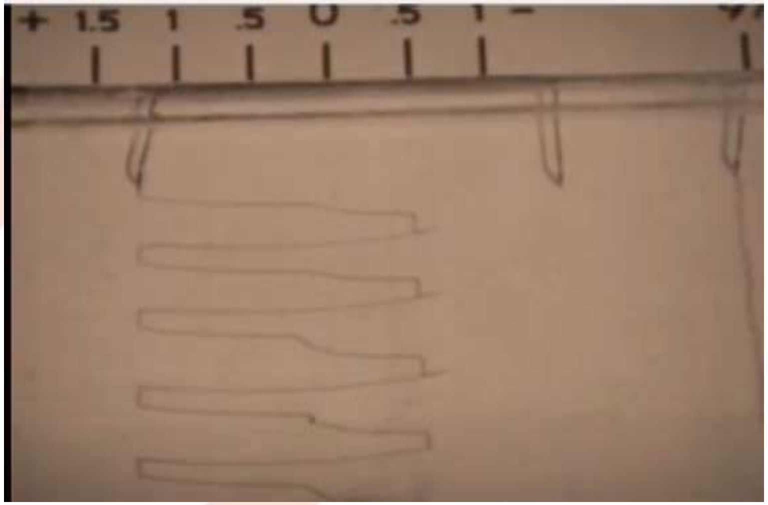


William Bennett Kouwenhoven

1960: the modern concept of closed ***CHEST COMPRESSION***

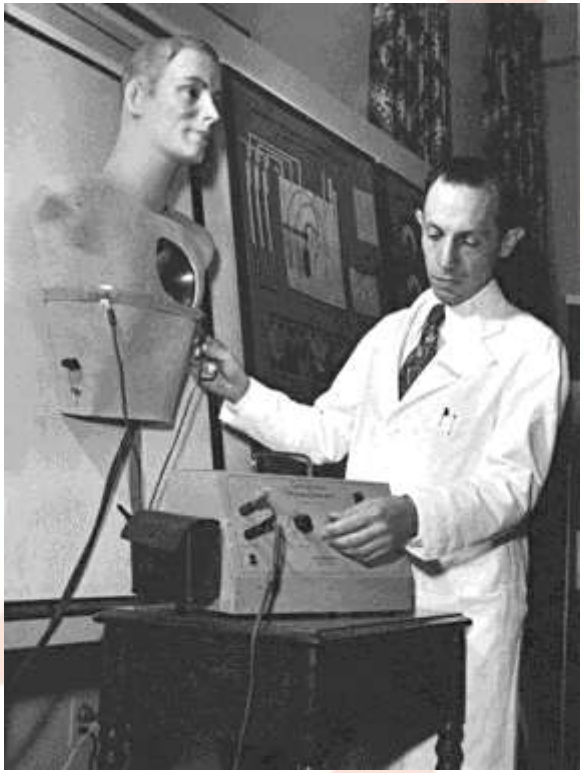


Peter Safar

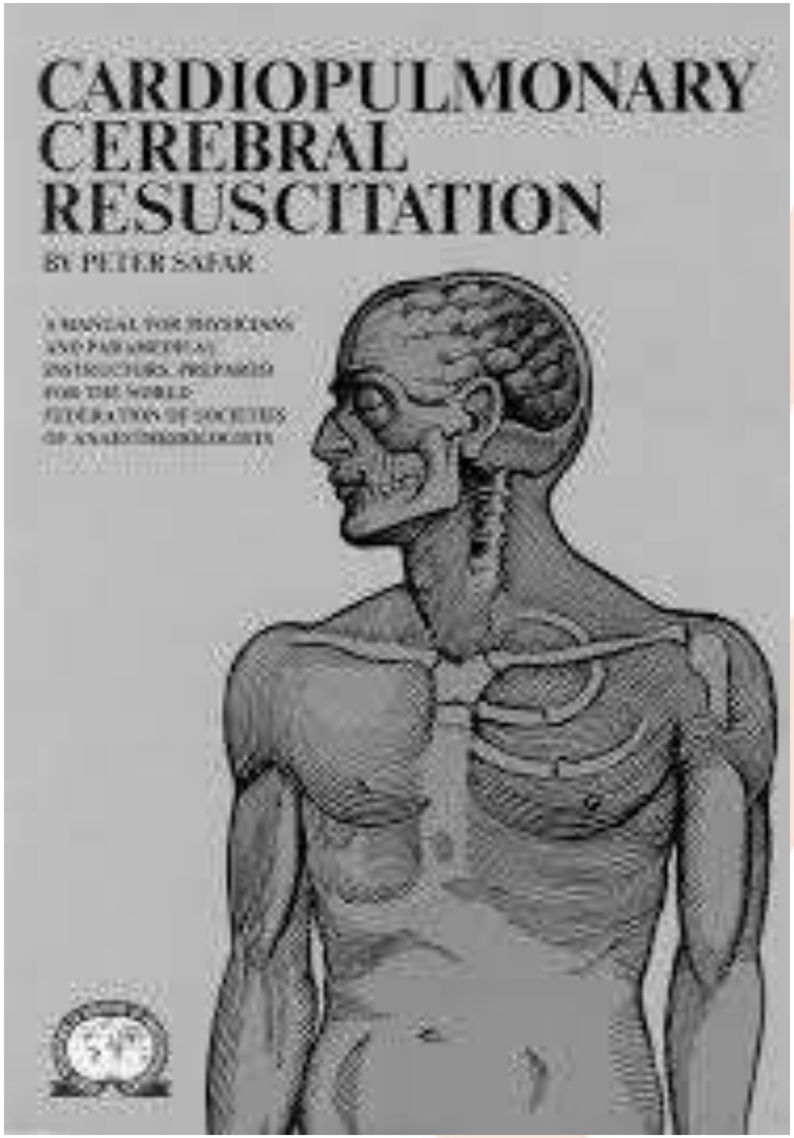


<u>VENTILATIONS</u>

DEFIBRILLATION



Paul M. Zoll



First Guidelines 1960

coscienza

vie aeree

respiro/GAS

chiamata 118/112

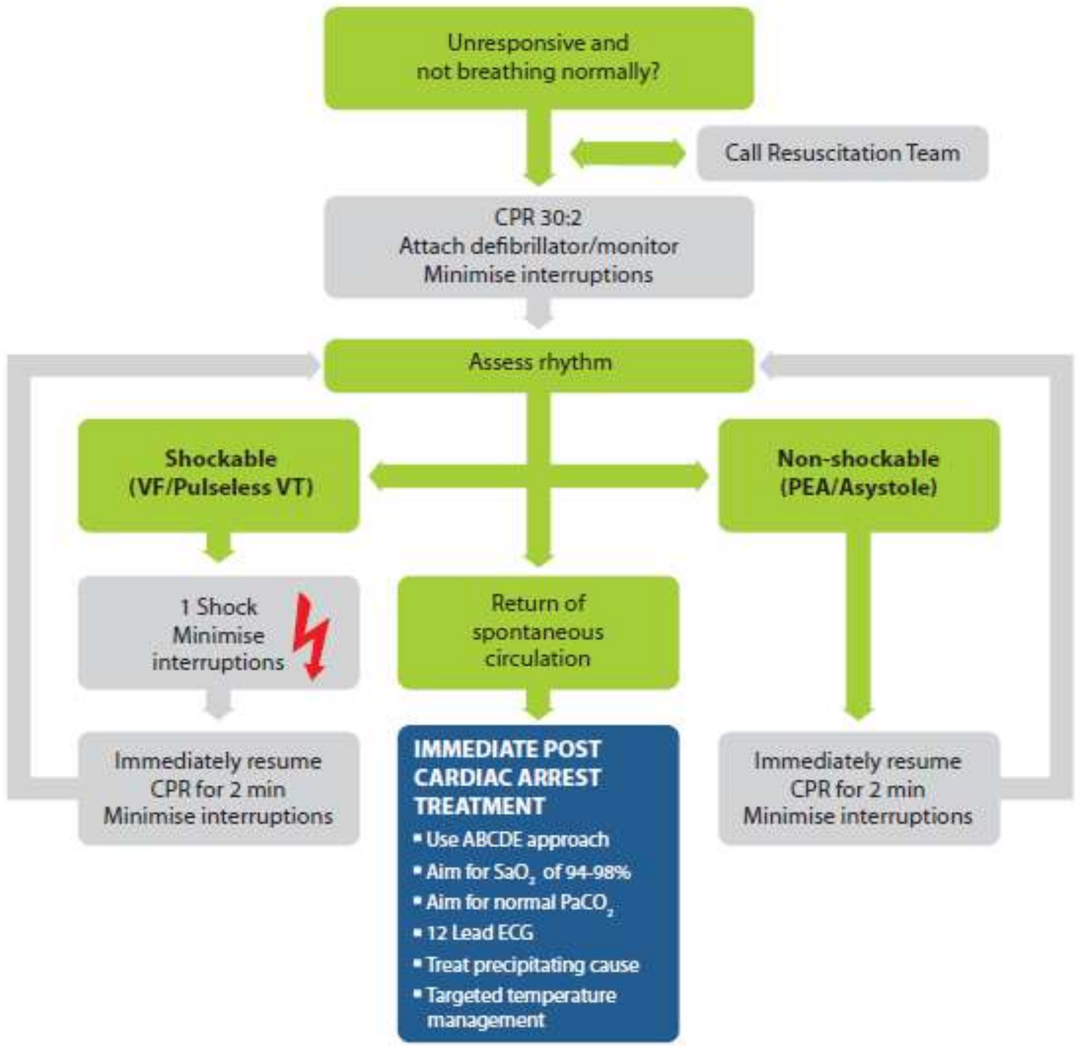
DAE

compressioni toraciche

ventilazioni (30:2)

BLSD/minimizza pause

Advanced Life Support



EUROPEAN RESUSCITATION COUNCIL

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

TREAT REVERSIBLE CAUSES

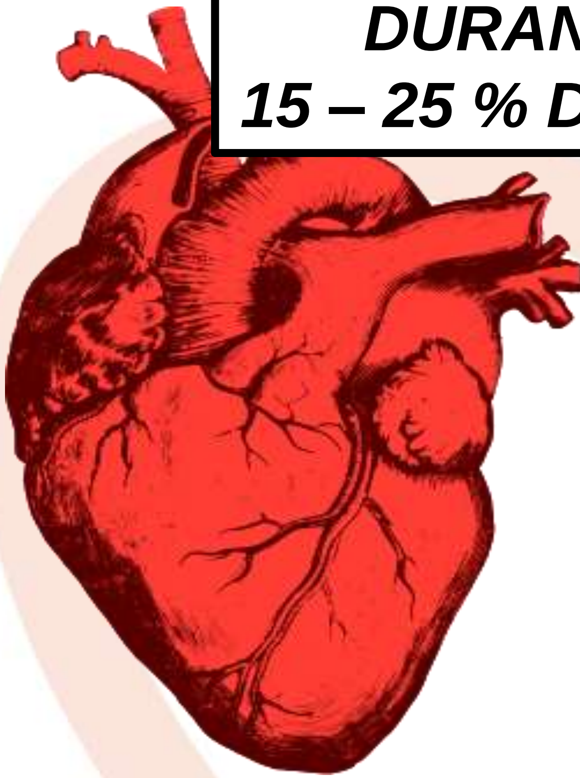
Hypoxia	Thrombosis – coronary or pulmonary
Hypovolaemia	Tension pneumothorax
Hypo-/hyperkalaemia/metabolic	Tamponade – cardiac
Hypothermia/hyperthermia	Toxins

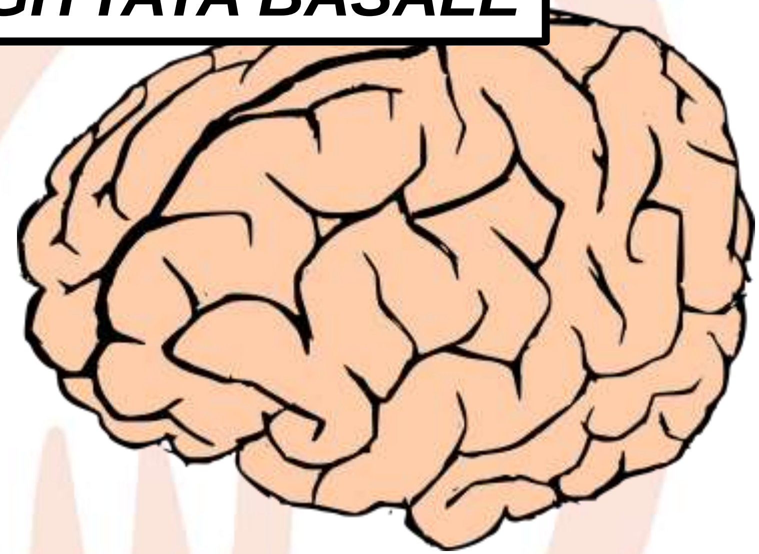
CONSIDER

- Ultrasound imaging
- Mechanical chest compressions to facilitate transfer/treatment
- Coronary angiography and percutaneous coronary intervention
- Extracorporeal CPR

L’arresto cardiocircolatorio è un evento improvviso, caratterizzato dalla cessazione dell’attività cardiaca e respiratoria, e da una rapida perdita di coscienza a seguito della conseguente interruzione della perfusione cerebrale.

DURANTE CPR OTTIMALE 15 – 25 % DELLA GITTATA BASALE



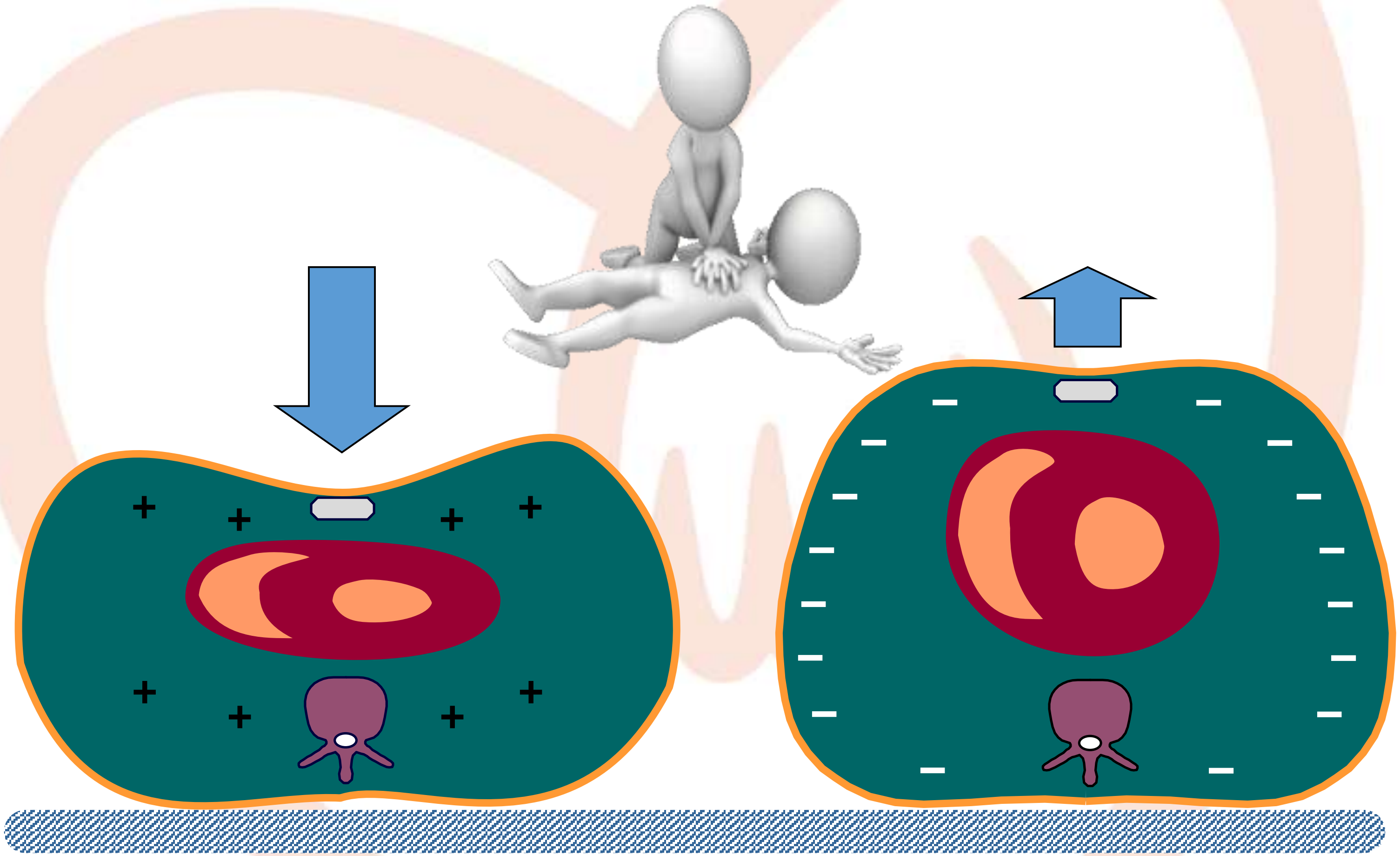


"The normal coronary blood flow is ~70 ml/100 g/min of heart weight or about 225 ml/min (~ 4 to 5 percent of the total cardiac output)"

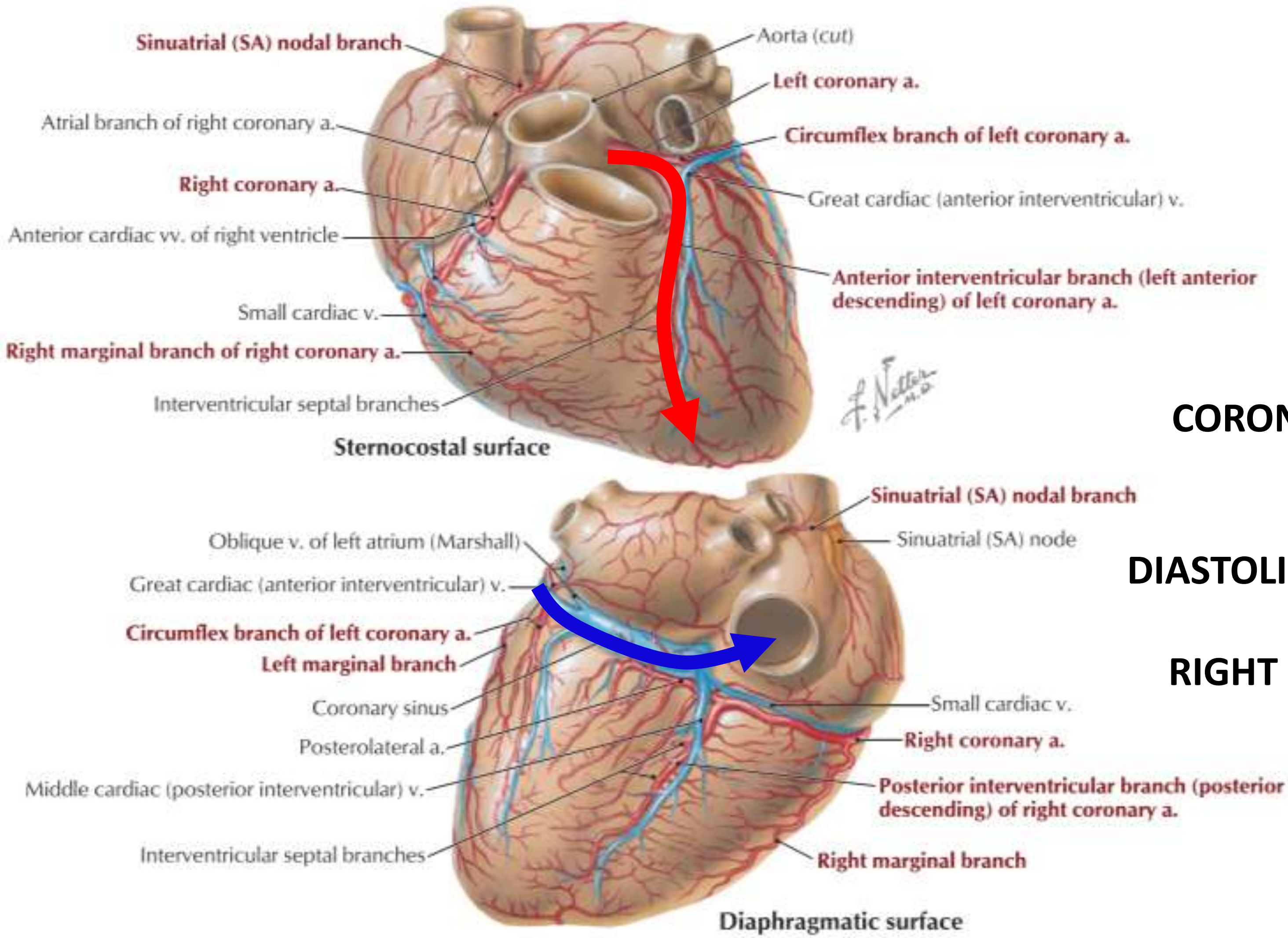
"Normal blood flow through the brain of the adult person averages 50 to 65 milliliters/ 100 g/min or about 750 to 900 ml/min. Brain constitutes 2 percent of the body weight but receives 15 percent of the resting cardiac output"

Guyton, Textbook of medical Physiology

CHEST COMPRESSION



Forward Blood Flow | **Venous Return**



CORONARY PERFUSION PRESSURE

=

DIASTOLIC AORTIC PRESSURE

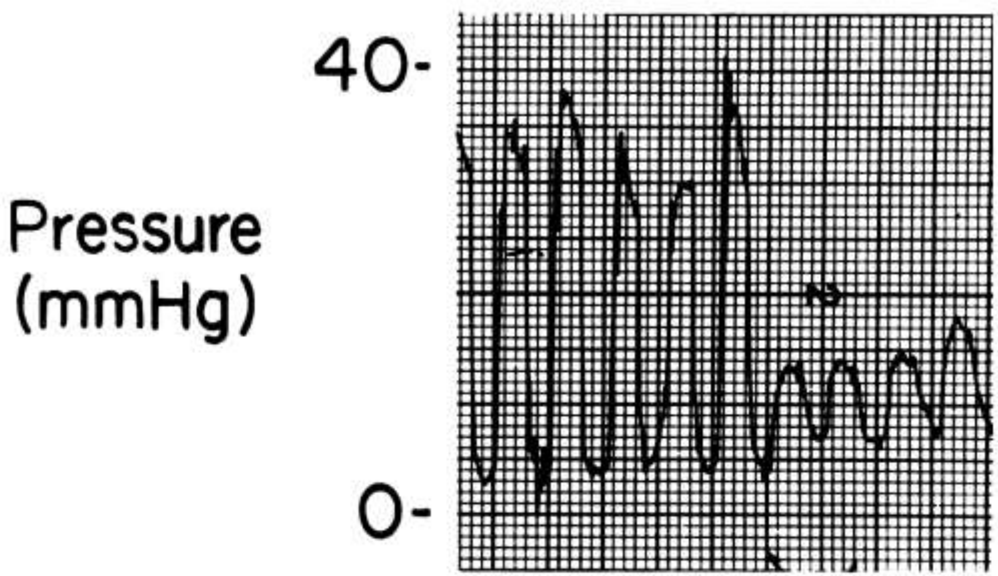
-

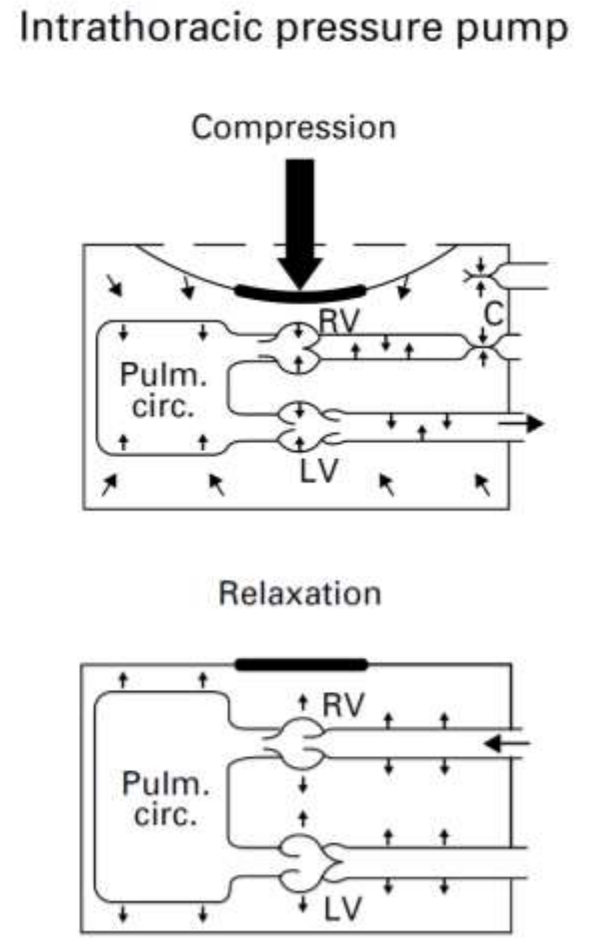
RIGHT ATRIAL PRESSURE

Una pressione di perfusione coronarica > 15-25 mmHg è associata ad una maggiore probabilità di ROSC

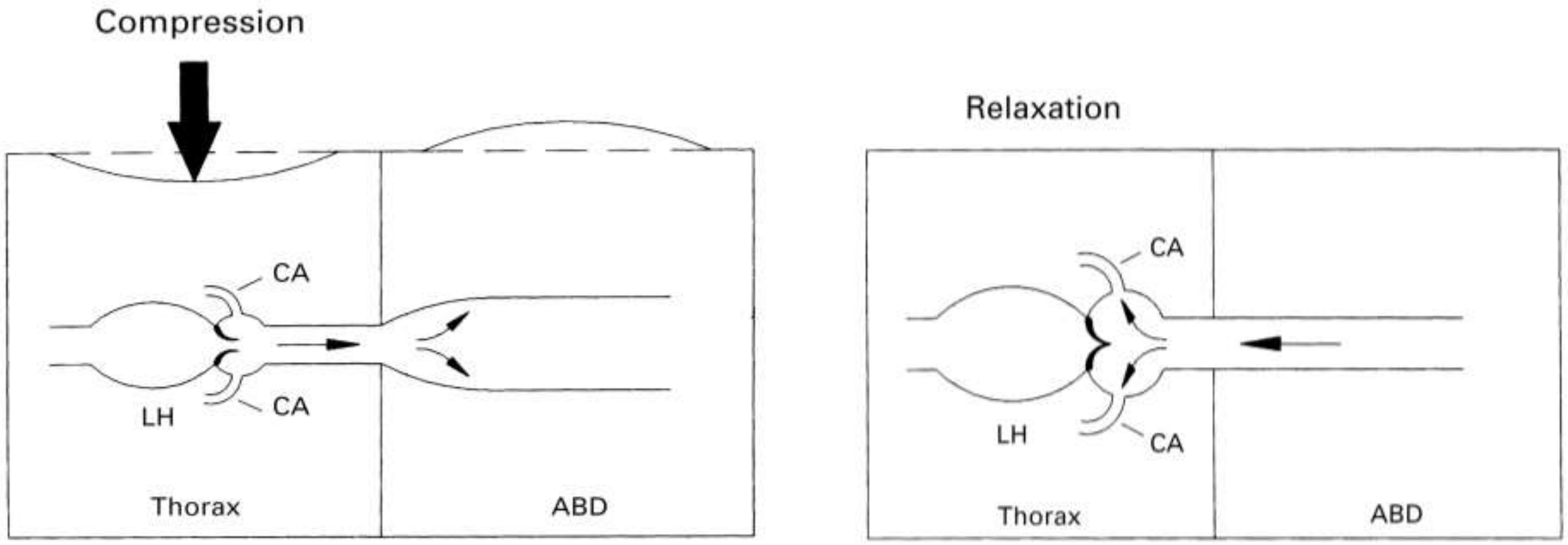
Babbs Crit Care Med 1980
Paradis et al. JAMA 1990

TEORIE A CONFRONTO





LA PERFUSIONE CORONARICA…



…ANCHE DURANTE CPR AVVIENE IN"DIASTOLE"

Review article

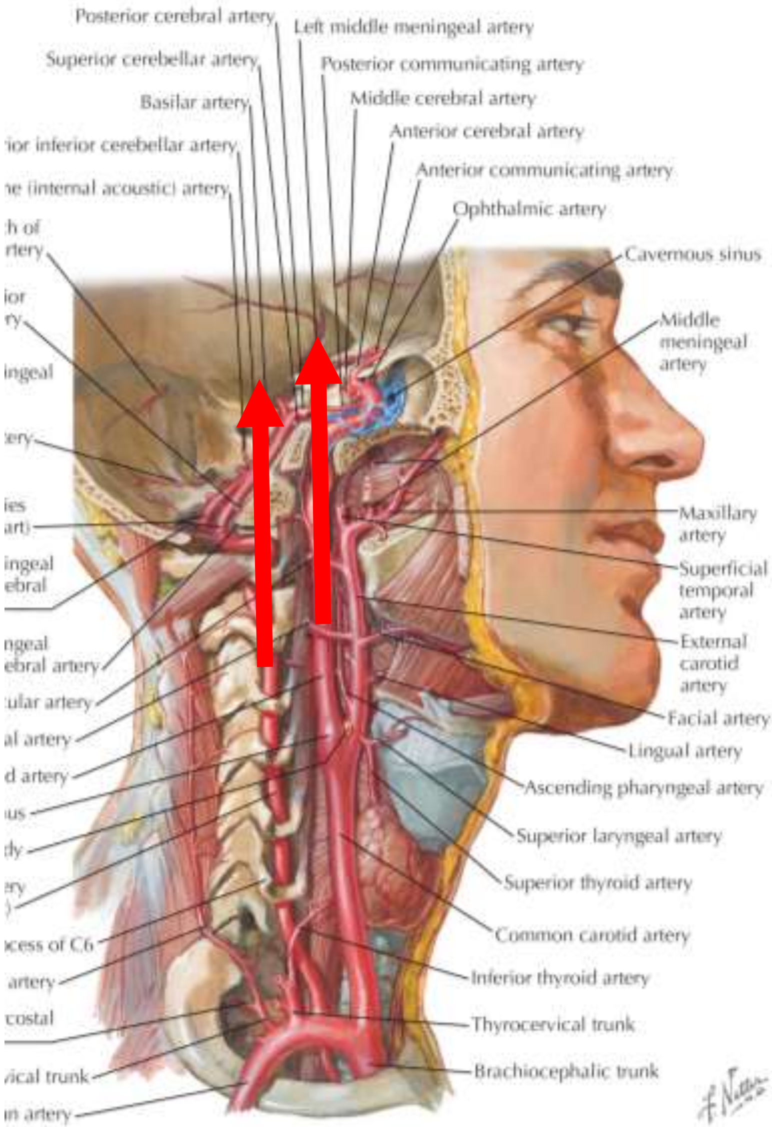
Systematic review of the mechanisms driving effective blood flow during adult CPR☆

Marios Georgiou[a,b], Elizabeth Papathanassoglou[b,c], Theodoros Xanthos[d,e,*]

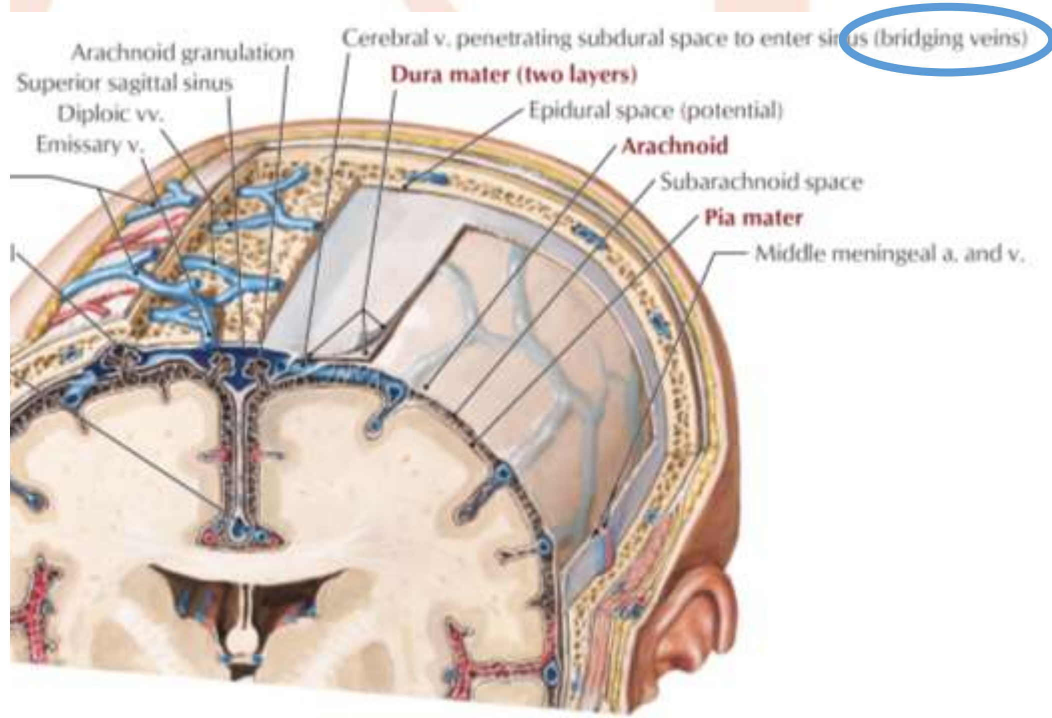
Resuscitation 85 (2014) 1586–1593

Table 2
Blood flow during chest decompression.

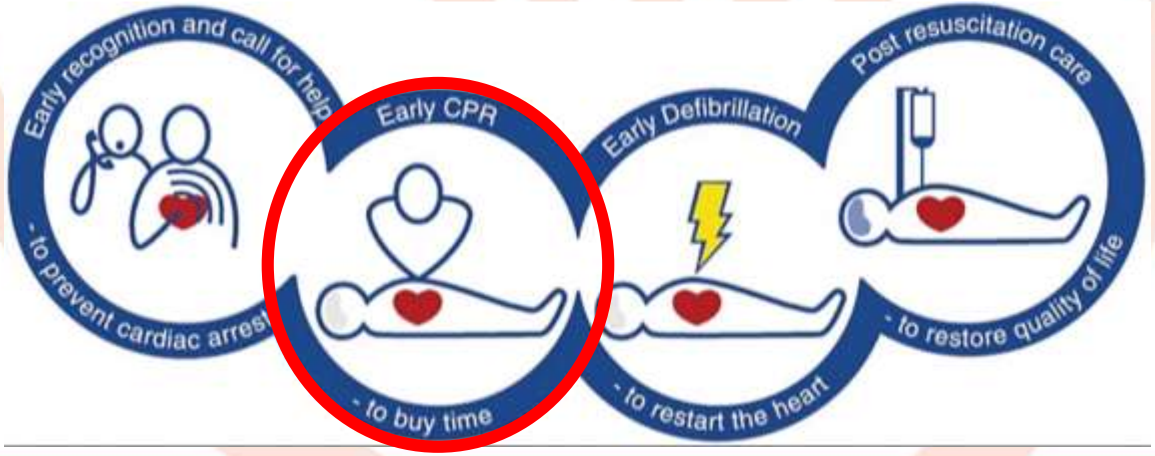
Author (year)	Population	Method for determination of blood flow	Mechanism of blood flow	Comments
Yannopoulos et al. (2004)[25]	Swine	Invasive measurements	Decrease in intrathoracic pressure	Evidence indirectly supporting the cardiac pump
Lurie et al. (2001)[26]	Swine	Radiolabeled microspheres	Decrease in intrathoracic pressure	Evidence indirectly supporting the cardiac pump
Rubertsson et al. (1995)[27]	Swine	Transit-time ultrasound flowmetry	Decrease in intrathoracic pressure	Evidence supporting the thoracic pump
Bellamy et al. (1984)[28]	Swine	Electromagnetic cuff flow probes/radiomicrospheres	Decrease in intrathoracic pressure	Evidence indirectly supporting the cardiac pump
Kern et al. (1994)[29]	Swine	Intracoronary Doppler catheter	Decrease in intrathoracic pressure	Evidence indirectly supporting both cardiac and thoracic pump
Yannopoulos et al. (2005)[30]	Swine	Invasive measurements	Decrease in intrathoracic pressure	–



CEREBRAL PERFUSION PRESSURE
=
MEAN AORTIC PRESSURE
-
INTRACRANIAL PRESSURE



"…if CPR is started immediately and "coronary perfusion pressures" are maintained above 25 mmHg, cerebral blood flow was maintained at approximately 60% of pre-cardiac arrest values, while when CPR was delayed for 6 min after cardiac arrest, a coronary perfusion pressure of 35 mmHg was required to produce similar cerebral blood flow. Furthermore, when CPR was delayed for 12 min, even this level of coronary perfusion pressure failed to restore cerebral blood flow, indicating the devastating effects of ischemic contracture on hemodynamics during CPR…"



RIANIMAZIONE CARDIOPOLMONARE DI ALTA QUALITA

- Frequenza adeguata (100-120 compressioni/min)
- Profondità adeguata (circa 50 mm, non >60 mm)
- Chest compression fraction > 60%
- Rapporto tra tempo di compressione e rilascio 1:1
- Evita qualunque pressione residua sul torace dopo rilascio
- Minimizza le interruzioni
- Cambia l’esecutore delle compressioni ogni 3-5 min
- Evita l’iperventilazione

Perkins GD et al, Resuscitation 2015

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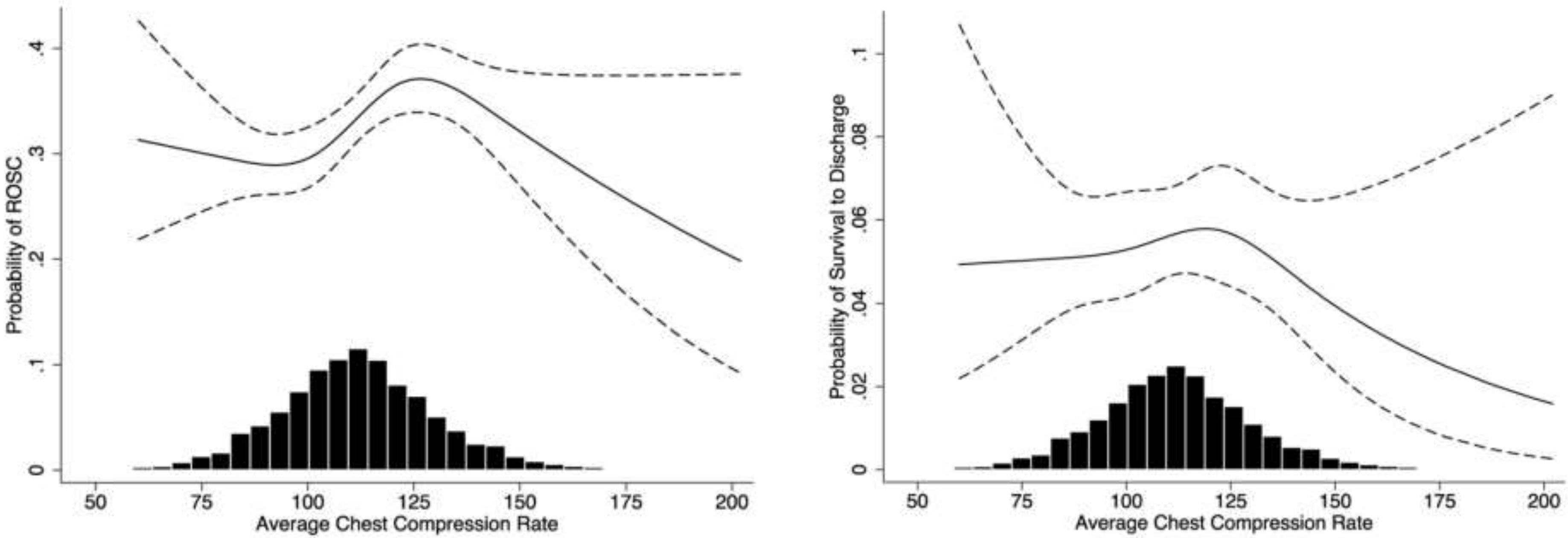
Perkins GD et al, Resuscitation 2015

Relationship Between Chest Compression Rates and Outcomes From Cardiac Arrest

Ahamed H. Idris, MD; Danielle Guffey, BS; Tom P. Aufderheide, MD; Siobhan Brown, PhD; Laurie J. Morrison, MD, MSc; Patrick Nichols, DO; Judy Powell, BSN; Mohamud Daya, MD; Blair L. Bigham, MSc; Dianne L. Atkins, MD; Robert Berg, MD; Dan Davis, MD; Ian Stiell, MD, MSc; George Sopko, MD, MPH; Graham Nichol, MD, MPH; the Resuscitation Outcomes Consortium (ROC) Investigators

Circulation. 2012;125:3004-3012

3.098 patients with OHCA



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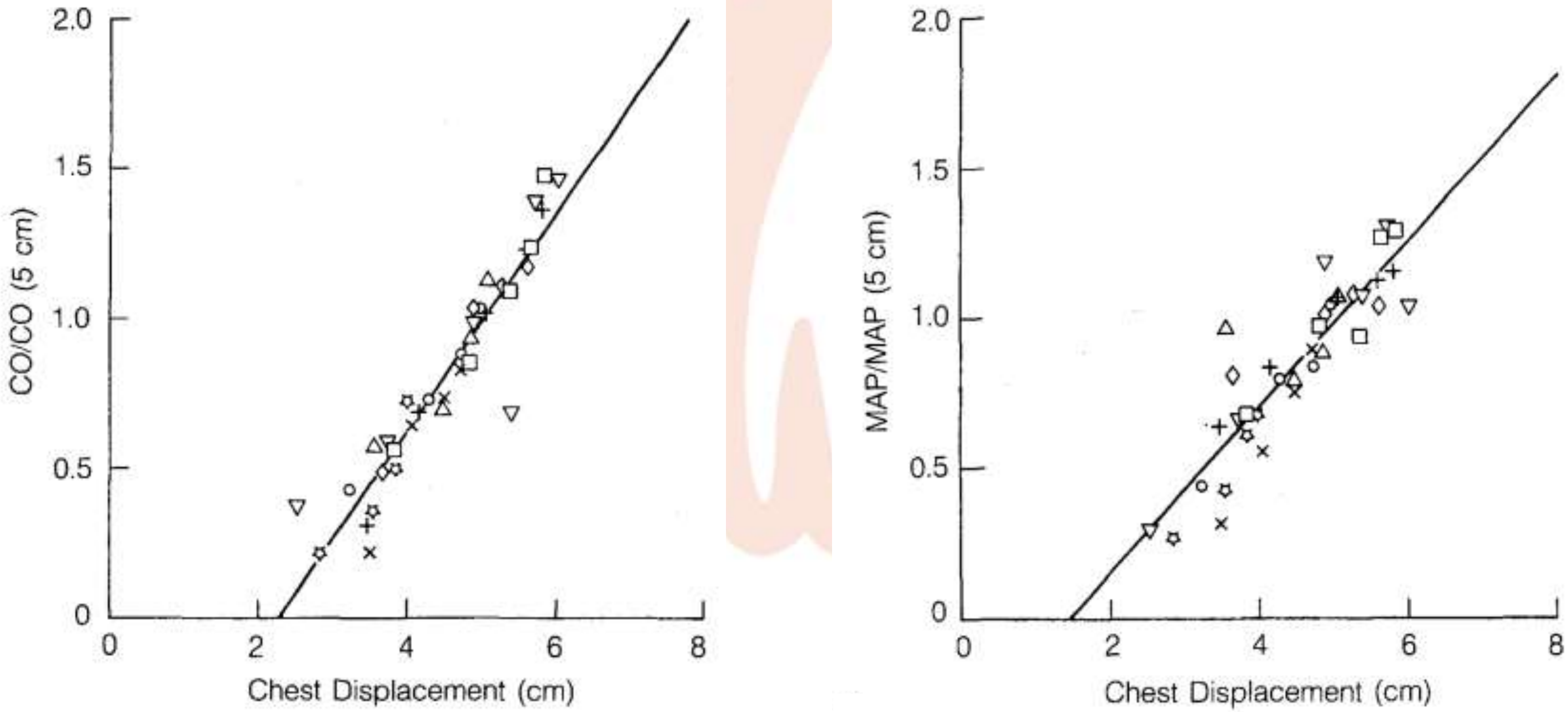
Perkins GD et al, Resuscitation 2015

Relationship of Blood Pressure and Flow During CPR to Chest Compression Amplitude: Evidence for an Effective Compression Threshold

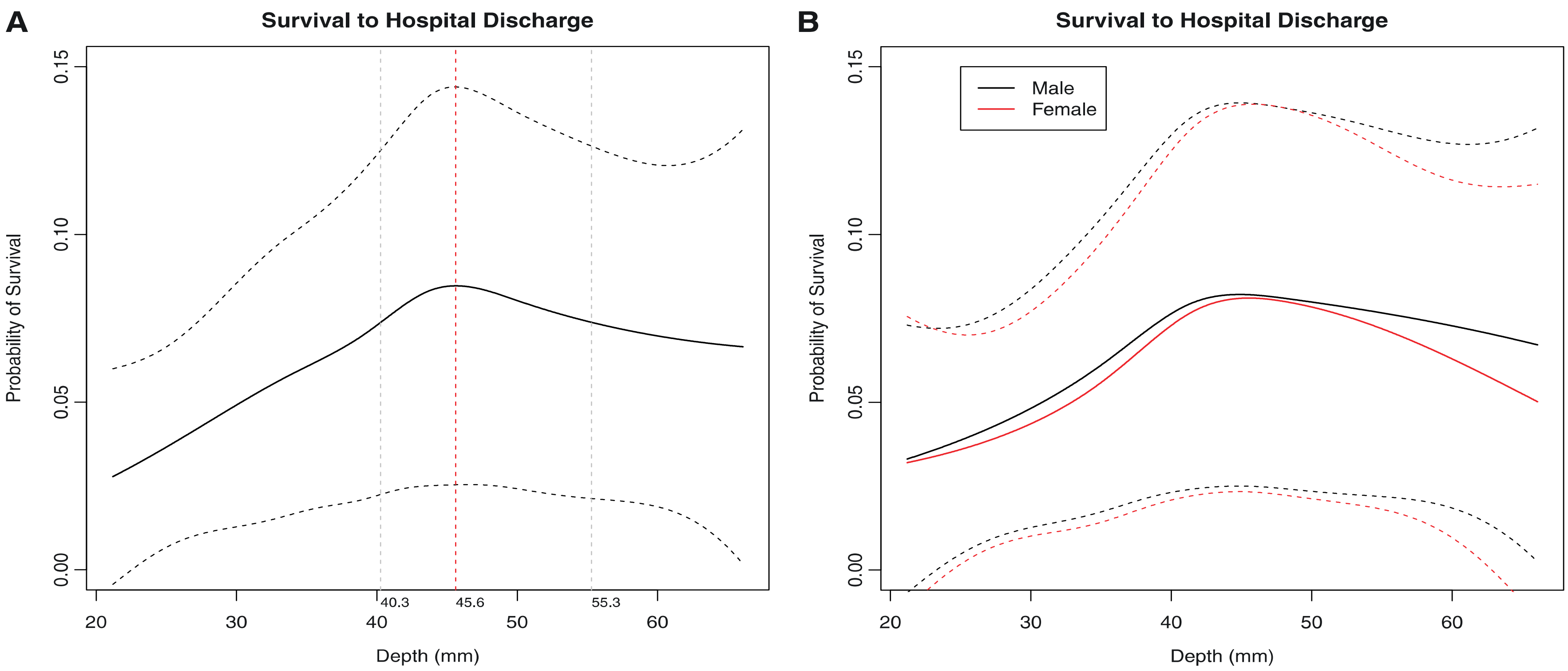


Babbs et al. Annals of Emergency Medicine 1983

What Is the Optimal Chest Compression Depth During Out-of-Hospital Cardiac Arrest Resuscitation of Adult Patients?

Ian G. Stiell, MD; Siobhan P. Brown, PhD; Graham Nichol, MD; Sheldon Cheskes, MD;
Christian Vaillancourt, MD; Clifton W. Callaway, MD; Laurie J. Morrison, MD;
James Christenson, MD; Tom P. Aufderheide, MD; Daniel P. Davis, MD; Cliff Free, EMT-P;
Dave Hostler, PhD; John A. Stouffer, EMT-P; Ahamed H. Idris, MD;
and the Resuscitation Outcomes Consortium Investigators

Circulation. 2014;130:1962-1970



Clinical paper

Deeper chest compression – More complications for cardiac arrest patients?☆

Heidi Hellevuo[a,b,*], Marko Sainio[b], Riikka Nevalainen[c], Heini Huhtala[d], Klaus T. Olkkola[e], Jyrki Tenhunen[b,f], Sanna Hoppu[b,g]

Resuscitation 84 (2013) 760–765

Injuries associated with chest compressions.

		All patients n = 170 n (%)	Male n = 110 (65) n (%)	Female n = 60 (35) n (%)
Thorax				
	Rib fracture	41/153 (26.8)	30/97 (30.9)	11/56 (19.6)
	Single		7	3
	Multiple		23	8
	Sternal fracture	16/153 (10.5)	11/97 (11.3)	5/56 (8.9)
	Haematoma – rib fractures	11/41 (26.8)	7/80 (8.8)	4/52 (7.7)
	Mediastinal haemorrhage	1 (0.8)	0	1/49 (2.0)
	Pneumothorax	2/168 (1.2)	2/110 (1.8)	0
	Haemothorax	0	0	0
Lung				
	Contusion – lung	1/134 (0.7)	0	1/51 (2.0)
Heart and great vessels				
	Haematoma/rupture – heart	8/127 (6.3)	6/80 (7.5)	2/47 (4.3)
	Posterior haematoma	*3*	*2*	*1*
	Rupture	*5*	*4*	*1*
	Great vessels	2/126 (1.6)	2/79 (2.5)	0
Abdomen				
	Liver rupture	0	0	0
	Spleen rupture	1/125 (0.8)	1/78 (1.3)	0
	Gastric rupture	1/125 (0.8)	0	1/47 (2.1)

The injuries are presented as number and percentage of patients. Number of patients in each injury category varies on the basis of injury detection method.

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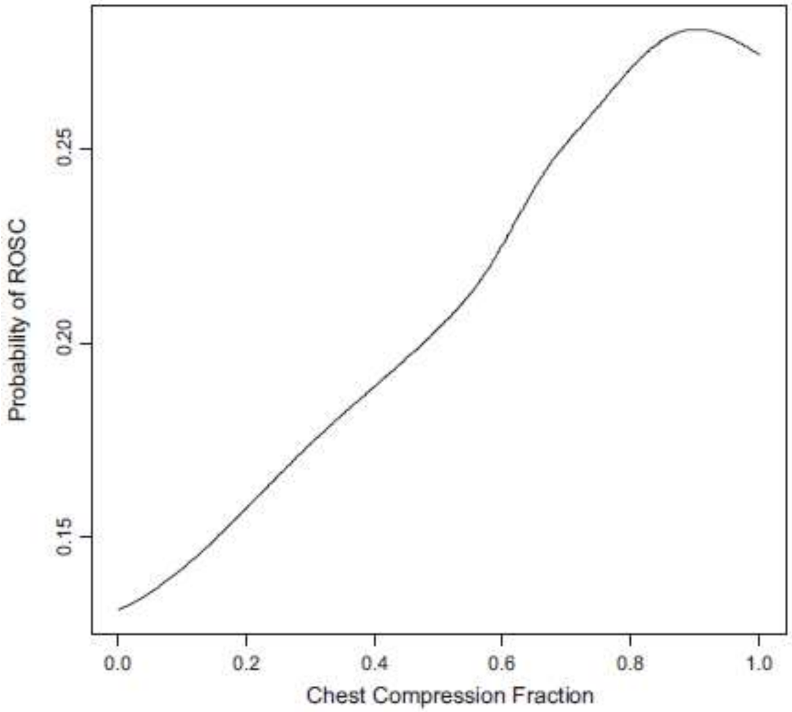
Perkins GD et al, Resuscitation 2015

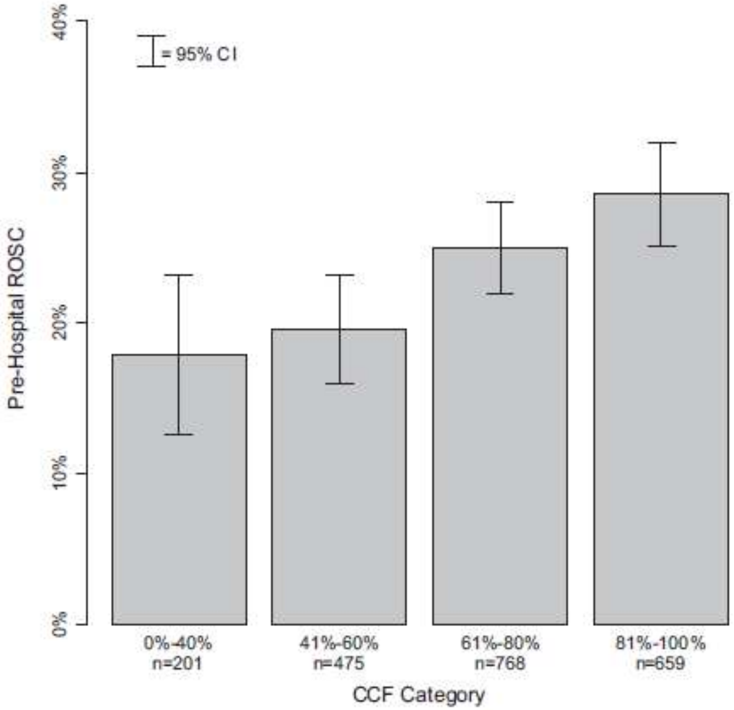
The impact of increased chest compression fraction on return of spontaneous circulation for out-of-hospital cardiac arrest patients not in ventricular fibrillation☆

Christian Vaillancourt[a,*], Siobhan Everson-Stewart[b], Jim Christenson[c], Douglas Andrusiek[c], Judy Powell[b], Graham Nichol[b], Sheldon Cheskes[d], Tom P. Aufderheide[e], Robert Berg[f], Ian G. Stiell[a], the Resuscitation Outcomes Consortium Investigators

Resuscitation 82 (2011) 1501–1507

2.103 adult patients from 10 U.S. and Canadian centers





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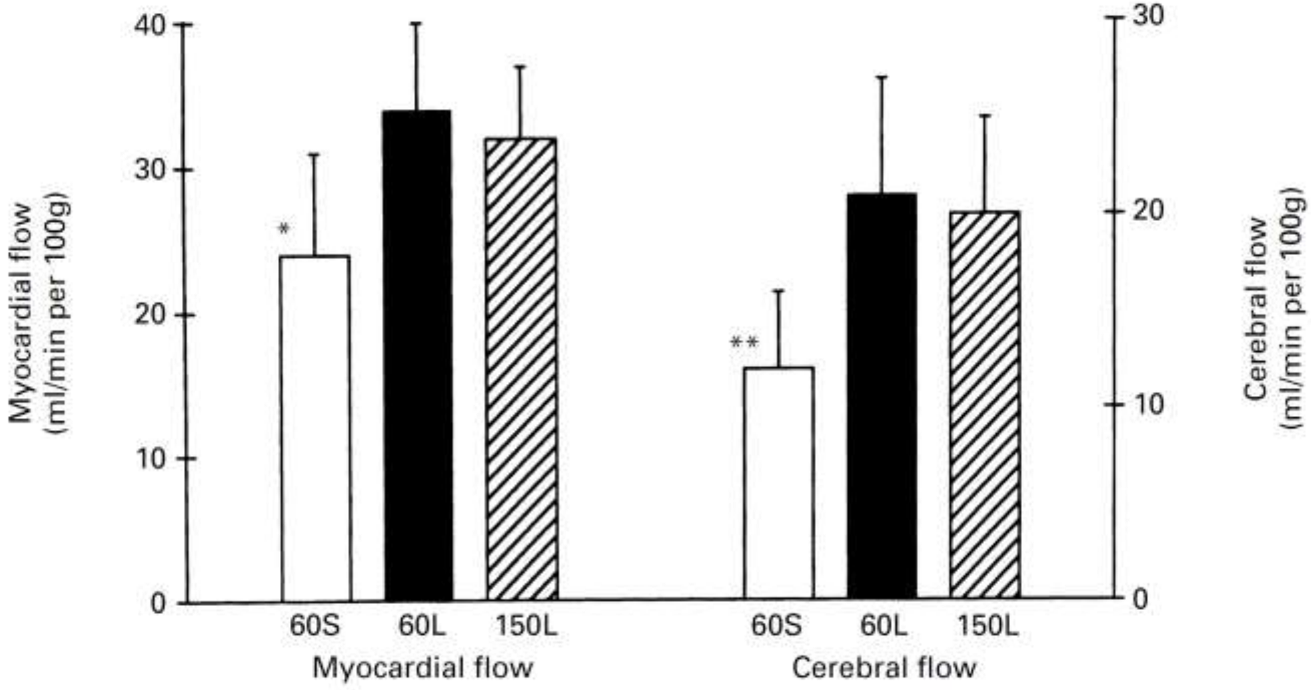
Perkins GD et al, Resuscitation 2015

Determinants of blood flow to vital organs during cardiopulmonary resuscitation in dogs

HENRY R. HALPERIN, M.D., JOSHUA E. TSITLIK, PH.D., ALAN D. GUERCI, M.D.,
E. DAVID MELLITS, SC.D., HOWARD R. LEVIN, M.S., AN-YUN SHI, M.D.,* NISHA CHANDRA, M.D.,
AND MYRON L. WEISFELDT, M.D.

Circulation 73, No. 3, 539–550, 1986.



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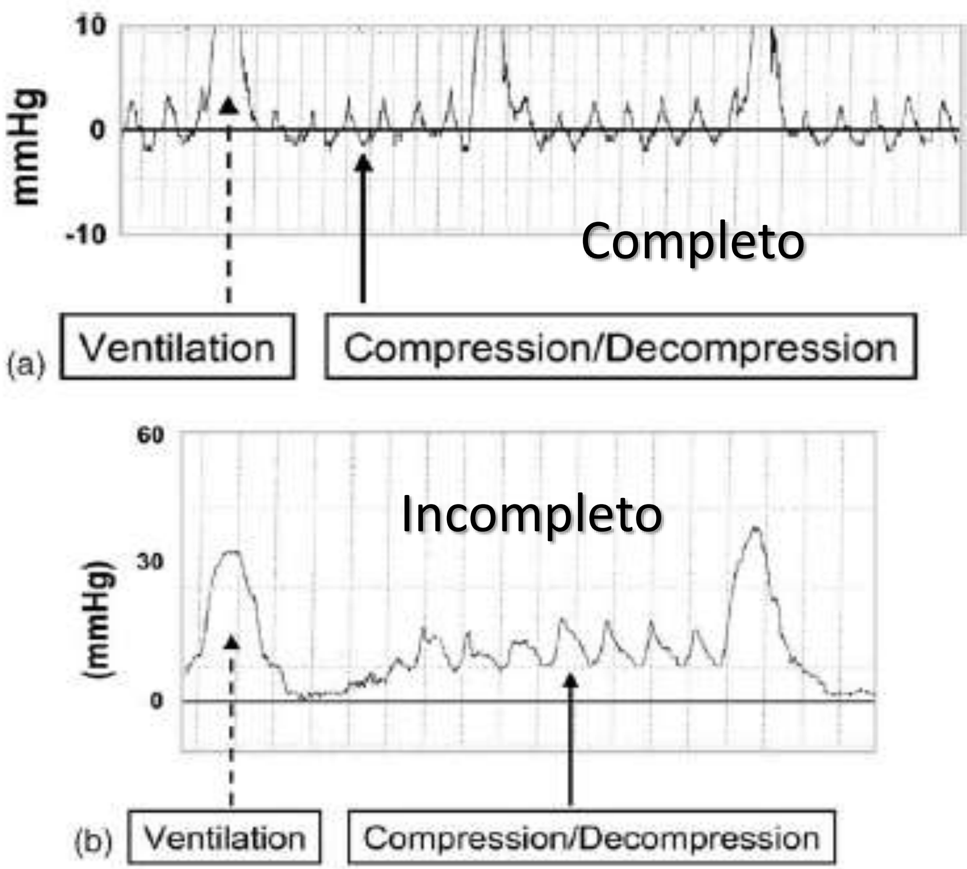
Perkins GD et al, Resuscitation 2015

Chest Recoil and Intrathoracic Pressure



T.P. Aufderheide et al. / Resuscitation 64 (2005) 353–362

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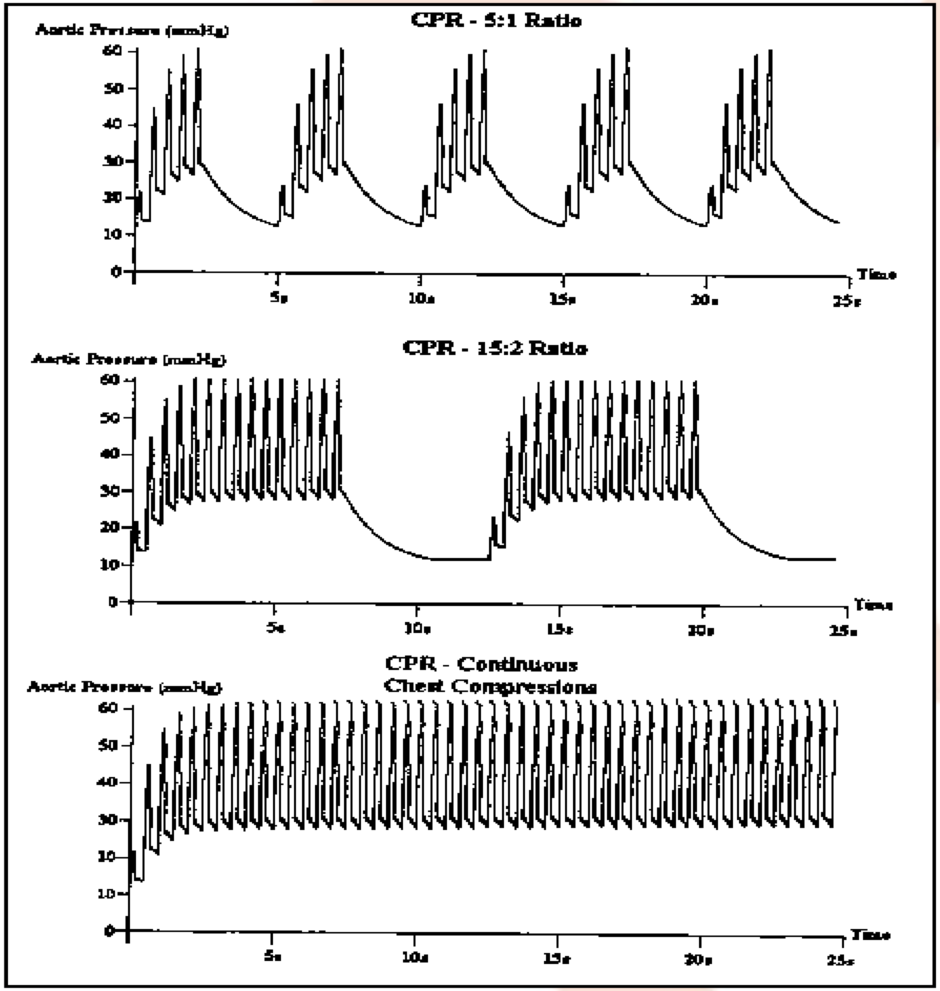
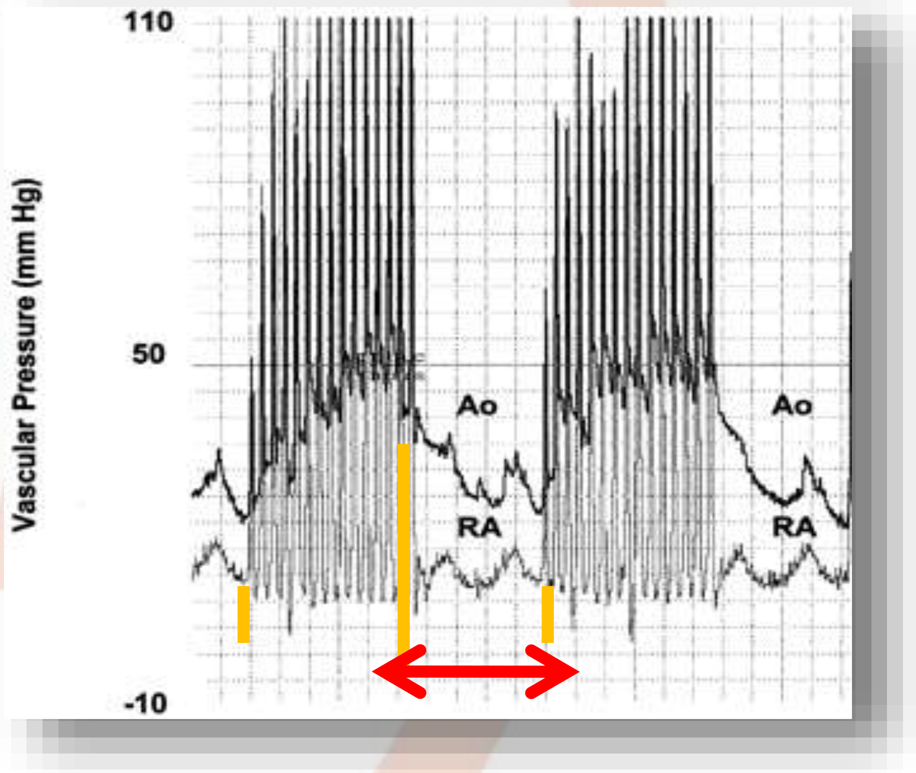
Perkins GD et al, Resuscitation 2015

Minimize compression interruptions





Berg RA, Circulation 2001;104:2465

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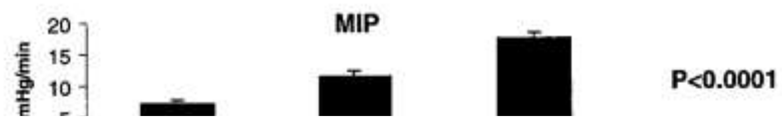
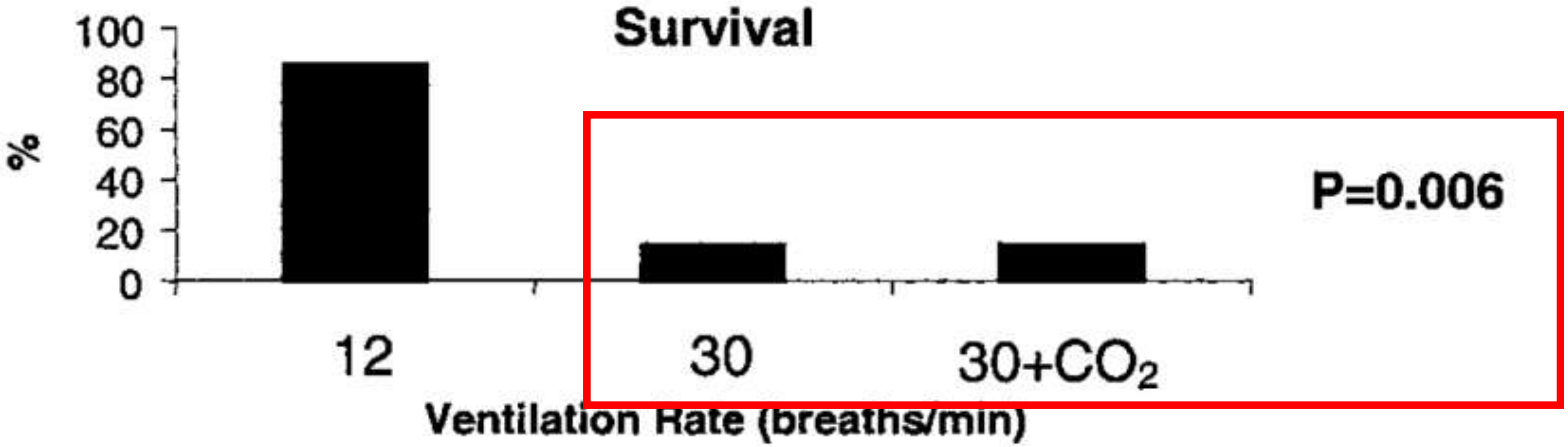
- **Evita l'iperventilazione**

Perkins GD et al, Resuscitation 2015

Hyperventilation-Induced Hypotension During Cardiopulmonary Resuscitation

Tom P. Aufderheide, MD; Gardar Sigurdsson, MD; Ronald G. Pirrallo, MD, MHSA;
Demetris Yannopoulos, MD; Scott McKnite, BA; Chris von Briesen, BA, EMT;
Christopher W. Sparks, EMT; Craig J. Conrad, RN; Terry A. Provo, BA, EMT-P; Keith G. Lurie, MD

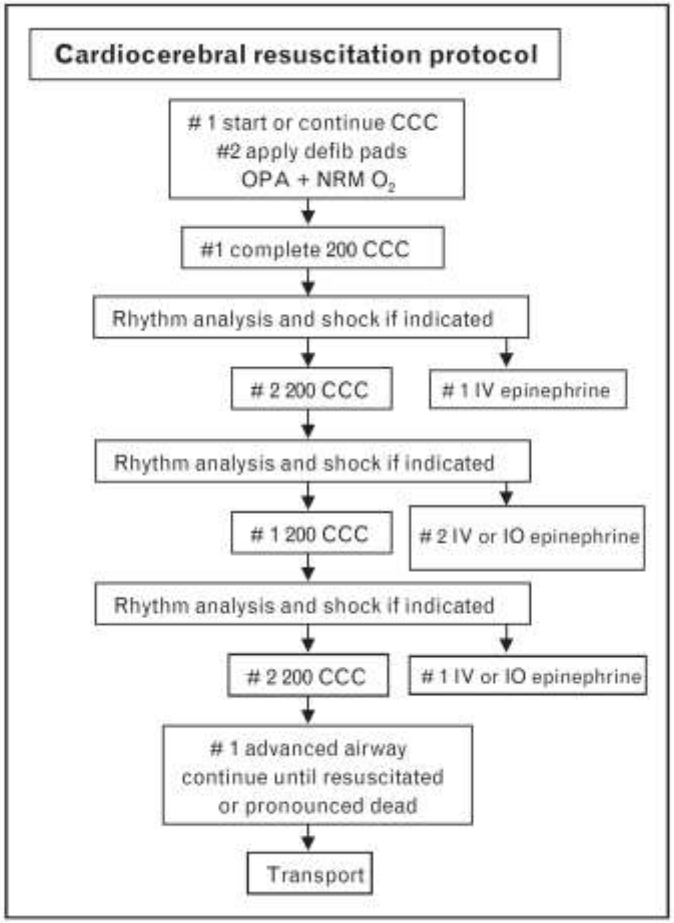




Circulation 2004

Cardiocerebral resuscitation: a better approach to cardiac arrest

Gordon A. Ewy



EVITA DI VENTILARE!!!

1. ↑ pressioni intratoraciche

↓

↑ pressione atrio destro

↓

↓ driving pressure

- Ritorno venoso
- Perfusione coronarica
- Perfusione cerebrale

2. ↓ chest compression fraction
3. Sfrutta la «ventilazione» offerta dalle variazioni di pressione intratoracica determinata dal massaggio cardiaco

Quality of Cardiopulmonary Resuscitation During Out-of-Hospital Cardiac Arrest

Lars Wik, MD, PhD
Jo Kramer-Johansen, MD
Helge Myklebust, BEng
Hallstein Sorebo, MD
Leif Svensson, MD
Bob Fellows, MD
Petter Andreas Steen, MD, PhD

Context Cardiopulmonary resuscitation (CPR) guidelines recommend target values for compressions, ventilations, and CPR-free intervals allowed for rhythm analysis and defibrillation. There is little information on adherence to these guidelines during advanced cardiac life support in the field.

Objective To measure the quality of out-of-hospital CPR performed by ambulance personnel, as measured by adherence to CPR guidelines.

Design and Setting Case series of 1
arrest treated by paramedics and nurse
England, and Akershus, Norway, betwe
brillators recorded chest compressions
and ventilations by changes in thoracic
addition to standard event and electroc

Main Outcome Measure Adherenc

Results Chest compressions were not
without spontaneous circulation; this pe
subtracting the time necessary for electr
bining these data with a mean compres
when compressions were given resulted
CI, 61-67/min). Mean compression de
(95% CI, 24%-32%) of the compressi
lines recommendation), and the compr
CI, 41%-42%). A mean of 11 (95% C
Sixty-one patients (35%) had return of
discharged alive from the hospital had

Conclusions In this study of CPR dur
pressions were not delivered half of the
low. Electrocardiographic analysis and c
intervals without chest compressions.

JAMA. 2005;293:299-304

SINCE THE FIRST STANDARDS AND guidelines for cardiopulmonary resuscitation (CPR) were published 30 years ago[1] (with the latest update in 2000[2,3]) health care professionals in and out of the hospital have been trained accordingly around the world. The importance of CPR, defined as chest compressions and ventilation, for survival of cardiac arrest patients has been demonstrated,[4] and there are indications that the quality of CPR performance influences the outcome.[5-7]

When tested on mannequins, CPR quality performed by lay rescuers and health care professionals tends to deteriorate significantly within a few months after training,[8-10] but little is known about the quality of clinical performance on pa-

Quality of Cardiopulmonary Resuscitation During In-Hospital Cardiac Arrest

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Context The survival benefit of well-performed cardiopulmonary resuscitation (CPR) is well-documented, but little objective data exist regarding actual CPR quality during cardiac arrest. Recent studies have challenged the notion that CPR is uniformly performed according to established international guidelines.

Objectives To measure multiple parameters of in-hospital CPR quality and to determine compliance with published American Heart Association and international guidelines.

Design and Setting A prospective observational study of 67 patients who experienced in-hospital cardiac arrest at the University of Chicago Hospitals, Chicago, Ill, between December 11, 2002, and April 5, 2004. Using a monitor/defibrillator with novel additional sensing capabilities, the parameters of CPR quality including chest compression rate, compression depth, ventilation rate, and the fraction of arrest time without chest compressions (no-flow fraction) were recorded.

Main Outcome Measure Adherence to American Heart Association and international CPR guidelines.

Results Analysis of the first 5 minutes of each resuscitation by 30-second segments revealed that chest compression rates were less than 90/min in 28.1% of segments. Compression depth was too shallow (defined as <38 mm) for 37.4% of compressions. Ventilation rates were high, with 60.9% of segments containing a rate of more than 20/min. Additionally, the mean (SD) no-flow fraction was 0.24 (0.18). A 10-second pause each minute of arrest would yield a no-flow fraction of 0.17. A total of 27 patients (40.3%) achieved return of spontaneous circulation and 7 (10.4%) were discharged from the hospital.

Conclusions In this study of in-hospital cardiac arrest, the quality of multiple parameters of CPR was inconsistent and often did not meet published guideline recommendations, even when performed by well-trained hospital staff. The importance of high-quality CPR suggests the need for rescuer feedback and monitoring of CPR quality during resuscitation efforts.

JAMA. 2005;293:305-310

www.jama.com

SURVIVAL FROM CARDIAC ARREST remains low despite the introduction of cardiopulmonary resuscitation (CPR) more than 50 years ago.[1-3] The delivery of CPR, with correctly performed chest compressions and ventilations, exerts a significant survival benefit in both animal and human studies.[4-8] Conversely, interruptions in CPR or failure to provide compressions during cardiac arrest ("no-flow time") have been noted to have a negative impact on survival in animal studies.[7] Consensus guidelines clearly define how CPR is to be performed,[9] but the parameters of CPR in actual practice are not routinely measured, nor is the quality known.

There are multiple reasons for con-

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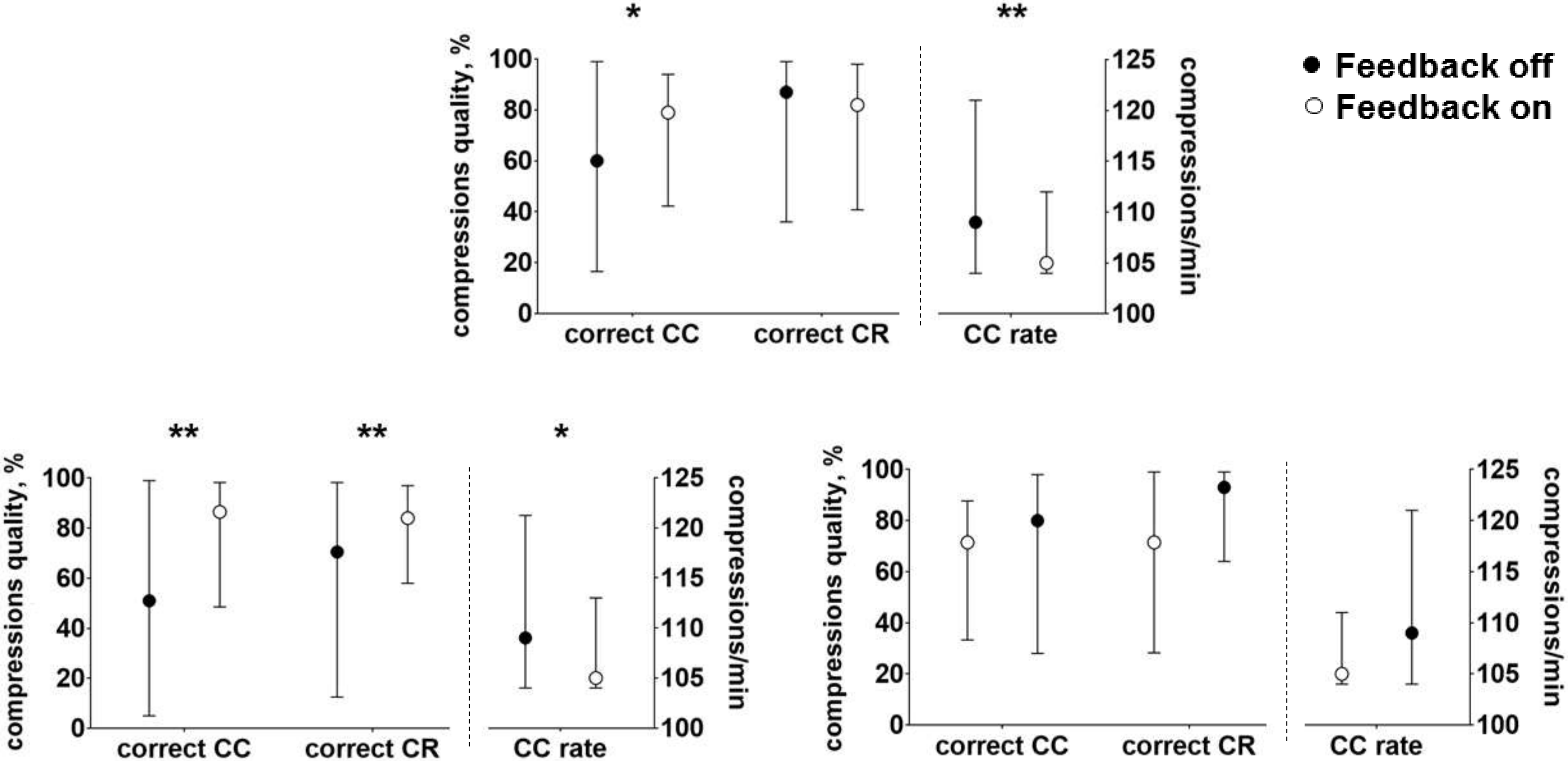
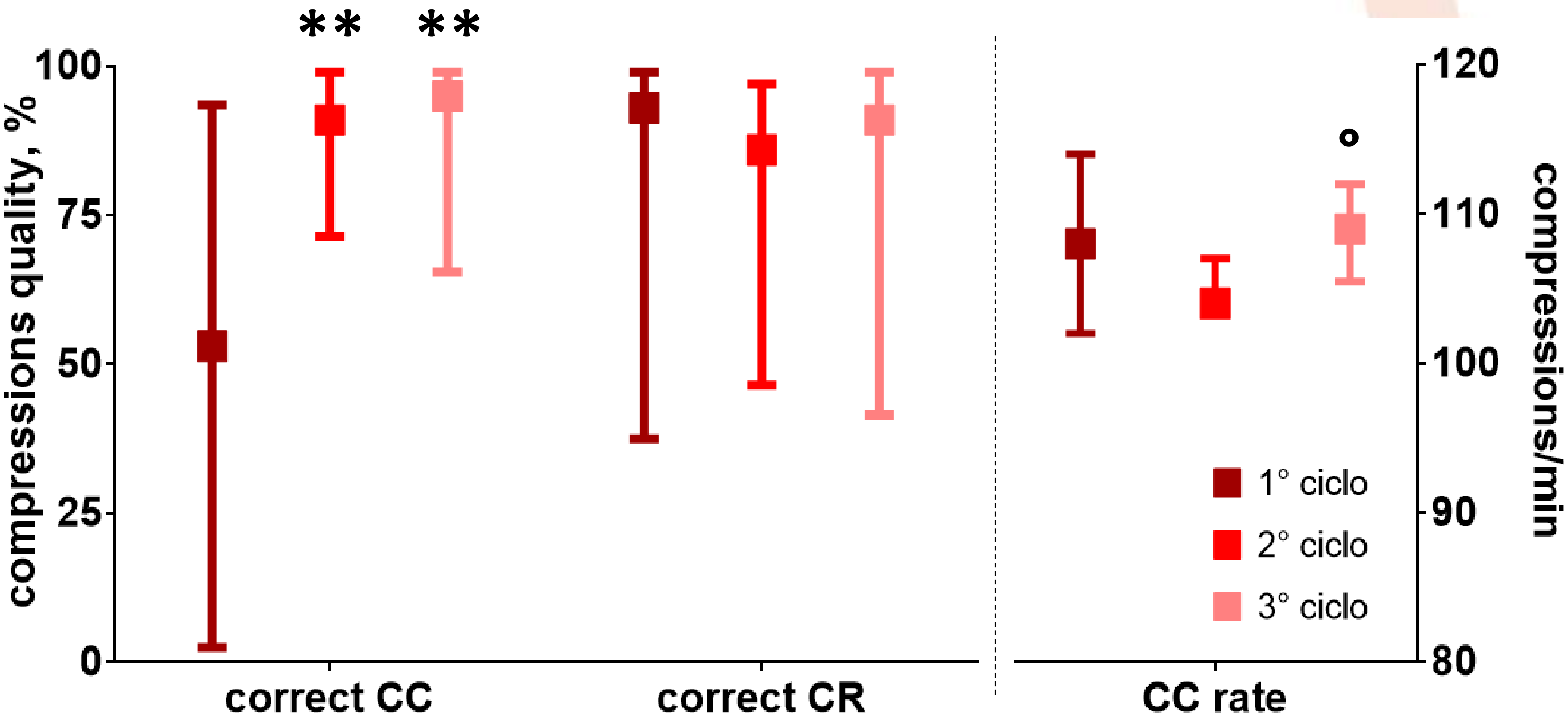


***p<0.05, **p<0.01**

CPR CHALLENGE CONGRESSO IRC 2016



*** p<0.05, ** p<0.01 vs 1° ciclo; ° p<0.05 vs 2° ciclo**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Experimental paper

Hemodynamic directed CPR improves short-term survival from asphyxia-associated cardiac arrest☆

Robert M. Sutton[a,*], Stuart H. Friess[a], Utpal Bhalala[a], Matthew R. Maltese[a], Maryam Y. Naim[a], George Bratinov[a], Dana Niles[a], Vinay M. Nadkarni[a], Lance B. Becker[b], Robert A. Berg[a]

Resuscitation 84 (2013) 696–701

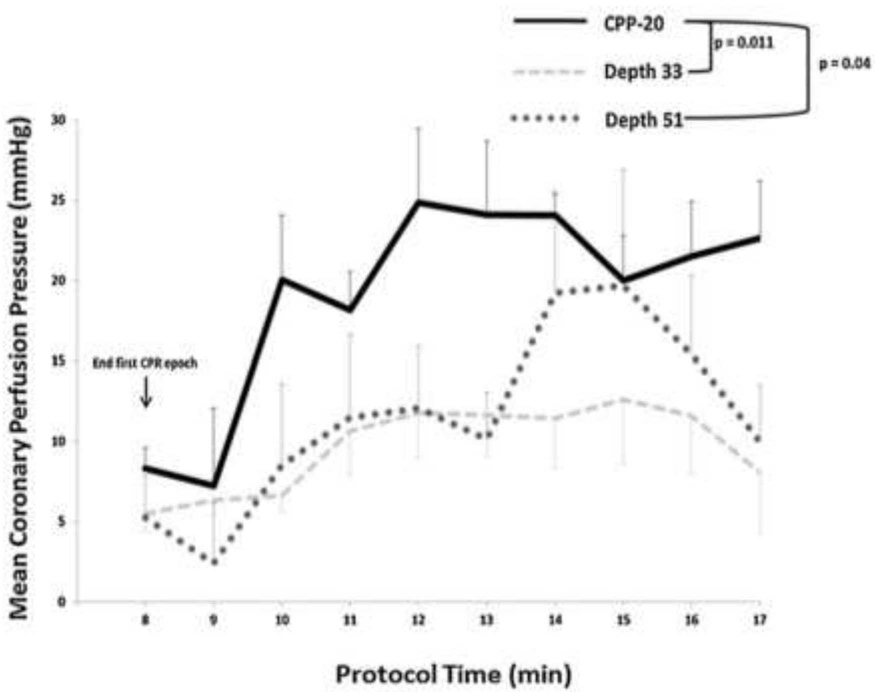


Table 2
Hemodynamic variables.

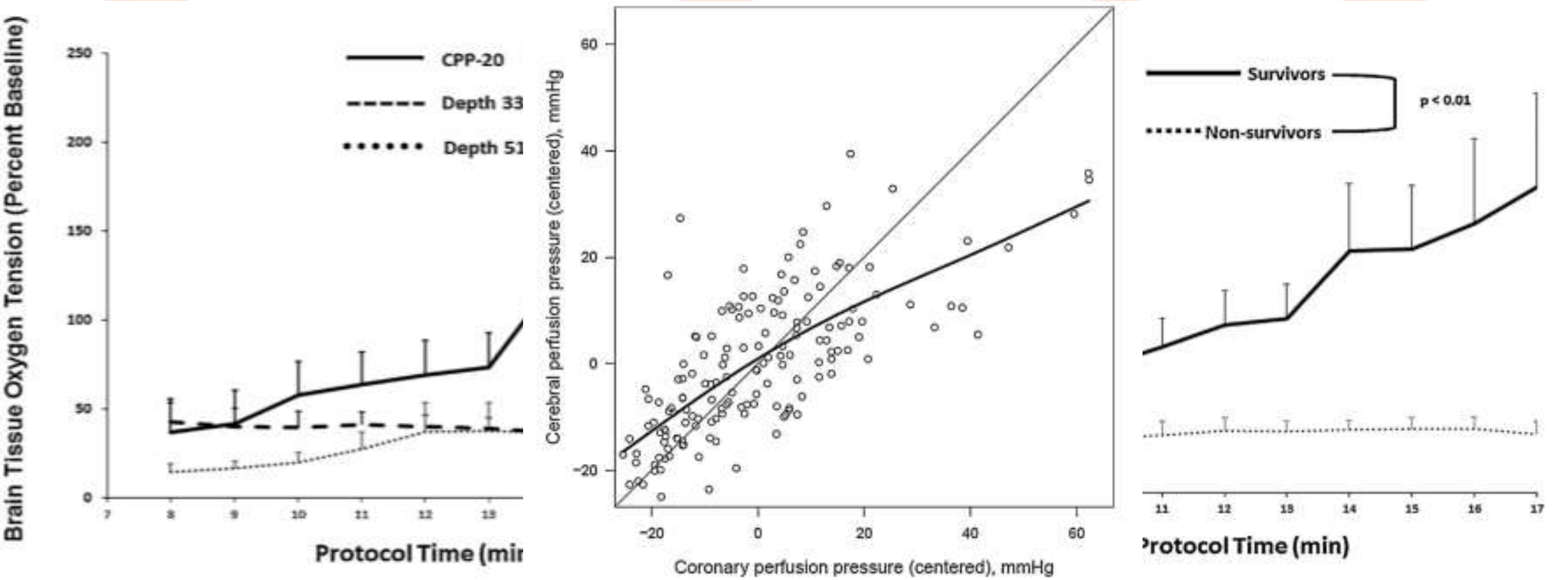
	Depth 33 ($n=5$)	Depth 51 ($n=5$)	CPP-20 ($n=5$)	p
Baseline				
CO (L/min)	2.8 (0.2)	2.9 (0.3)	2.9 (0.3)	0.89
Aos	87 (5)	108 (6)	105 (11)	0.17
AoD	64 (4)	85 (3)	81 (10)	0.09
RAD	6 (3)	10 (3)	6 (4)	0.65
CPP	58 (6)	76 (2)	75 (9)	0.13
End of asphyxial period[a]				
AoS	48 (13)	42 (10)	77 (21)	0.26
AoD	27 (4)	26 (4)	41 (8)	0.15
RAD	13 (1)	16 (2)	16 (3)	0.53
CPP	14 (4)	10 (5)	25 (5)	0.11
End of resuscitation period[b]				
AoS	45 (15)	111 (27)	120 (11)	0.03[‡,§]
AoD	18 (4)	29 (4)	38 (4)	0.02[‖]
RAD	10 (1)	20 (1)	16 (3)	0.03[¶]
CPP	8 (4)	10 (3)	23 (4)	0.03[**,††]
ET CO_2	20 (6)	30 (3)	21 (3)	0.18

Experimental paper

Hemodynamic directed CPR improves cerebral perfusion pressure and brain tissue oxygenation☆,☆☆

Stuart H. Friess[a,*], Robert M. Sutton[b], Benjamin French[c], Utpal Bhalala[d], Matthew R. Maltese[b], Maryam Y. Naim[b], George Bratinov[b], Silvana Arciniegas Rodriguez[b], Theodore R. Weiland[b], Mia Garuccio[b], Vinay M. Nadkarni[b], Lance B. Becker[e], Robert A. Berg[b]

Resuscitation 85 (2014) 1298–1303



Clinical paper

Physiologic monitoring of CPR quality during adult cardiac arrest: A propensity-matched cohort study☆

Robert M. Sutton[a,*], Benjamin French[b], Peter A. Meaney[a], Alexis A. Topjian[a], Christopher S. Parshuram[c], Dana P. Edelson[d], Stephen Schexnayder[e], Benjamin S. Abella[f], Raina M. Merchant[f], Melania Bembea[g], Robert. A. Berg[a], Vinay M. Nadkarni[a], for the American Heart Association's Get With The Guidelines–Resuscitation Investigators

Resuscitation 106 (2016) 76–82

23429 pazienti includibili → monitoraggio EtCO2 o DAP n=3032
nessun monitoraggio fisiologico n = 6064

Outcome primario ROSC; outcome secondario sopravvivenza e outcome neurologico

EtCO2 guided CPR n=803/213725 (8%); DAP guided CPR n=2145/7260 (30%)

"CPR quality was associated with higher odds of ROSC (OR 1.22, CI95 1.04–1.43, p = 0.017). Survival to hospital discharge (OR 1.04, CI95 0.92–1.18, p = 0.57) and survival with favorable neurological outcome (OR 0.97, CI95 0.75–1.26, p = 0.83) were not different between"

"Performing CPR without measuring the effects is like flying an airplane without an altimeter"

- Dr. Max Harry Weil at the Fourth Wolf Creek Conference, April 1996

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