CONGRESSO NAZIONALE IRC 2022

TRAUMA: NUOVE EVIDENZE E PERCORSI

AUDITORIUM DELLA TECNICA • ROMA • 14-15 OTTOBRE

IRC | Italian Resuscitation Council

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TRAUMA: NUOVE EVIDENZE E PERCORSI
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HIGH QUALITY CPR & ALS

Giuseppe Ristagno

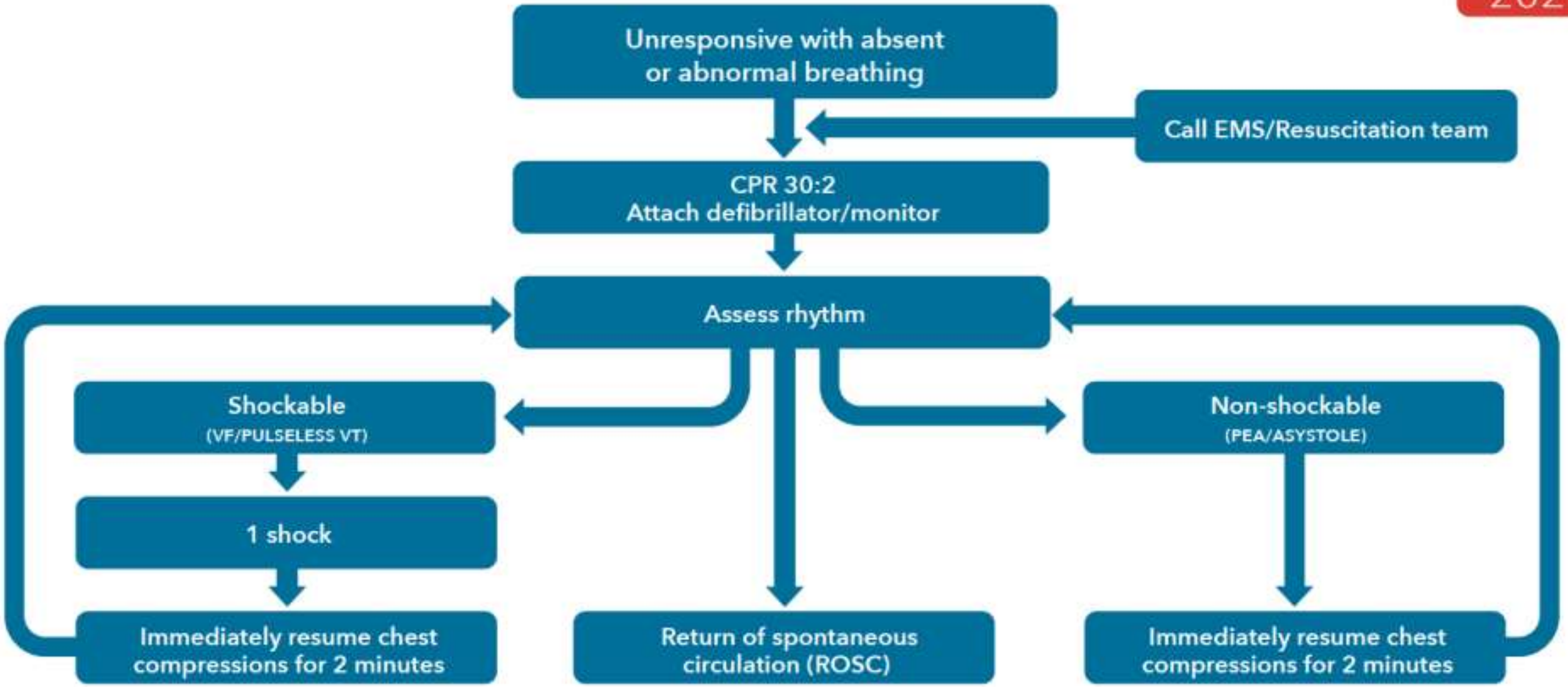
IRC Italian Resuscitation Council

«Highquality CPR» refers to strict adherence to recommendations for compression depth and frequency, minimizing interruptions and allowing full recoil

→ *all aspects comprised in a one-size-fits-all CPR-algorithm.*

ADVANCED LIFE SUPPORT

EUROPEAN RESUSCITATION COUNCIL
GUIDELINES 2021



Unresponsive with absent or abnormal breathing

Call EMS/Resuscitation team

CPR 30:2
Attach defibrillator/monitor

Assess rhythm

Shockable
(VF/PULSELESS VT)

1 shock

Immediately resume chest compressions for 2 minutes

Return of spontaneous circulation (ROSC)

Non-shockable
(PEA/ASYSTOLE)

Immediately resume chest compressions for 2 minutes

Give high-quality chest compressions and
- Give oxygen
- Use waveform capnography
- Continuous compressions if advanced airway
- Minimise interruptions to compressions
- Intravenous or intraosseous access
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks
- Identify and treat reversible causes

Identify and treat reversible causes
- Hypoxia
- Hypovolaemia
- Hypo-/hyperkalemia/metabolic
- Hypo-/hyperthermia
- Thrombosis - coronary or pulmonary
- Tension pneumothorax
- Tamponade- cardiac
- Toxins

Consider ultrasound imaging to identify reversible causes

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

After ROSC
- Use an ABCDE approach
- Aim for SpO_2 of 94-98% and normal $PaCO_2$
- 12 Lead ECG
- Identify and treat cause
- Targeted temperature management

an
uscitation
ncil

HIGH-QUALITY CPR AND EARLY DEFIBRILLATION

- Give high-quality chest compression with minimal interruption
- Give a shock as early as possible for a shockable cardiac arrest
- With a manual defibrillator aim for a total pause of less than 5 seconds

High quality CPR:

- Adequate depth (approximately 5 cm, but < 6 cm)
- Adequate rate (100-120/min)
- Duty cycle 50%
- Complete chest recoil
- Minimize interruptions

CPR MONITORING AND FEEDBACK DEVICES

- HEALTH CARE SYSTEMS:
  - Monitor CPR quality to improve key CPR metrics within your system
- INDIVIDUAL RESCUERS:
  - Audio-visual feedback and prompt devices that give real-time feedback to rescuers during CPR do not improve survival

VIDEO COMMUNICATION

RESUSCITATION [illegible]

Available online at www.sciencedirect.com

Resuscitation

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

ELSEVIER

EUROPEAN
RESUSCITATION
COUNCIL

Clinical paper

Comparison of the effects of audio-instructed and video-instructed dispatcher-assisted cardiopulmonary resuscitation on resuscitation outcomes after out-of-hospital cardiac arrest

Sun Young Lee[a], Kyoung Jun Song[b,], Sang Do Shin[c], Ki Jeong Hong[c], Tae Han Kim[b]*

1720 OHCA patients
(1489 and 231 in the audio and video groups, respectively)

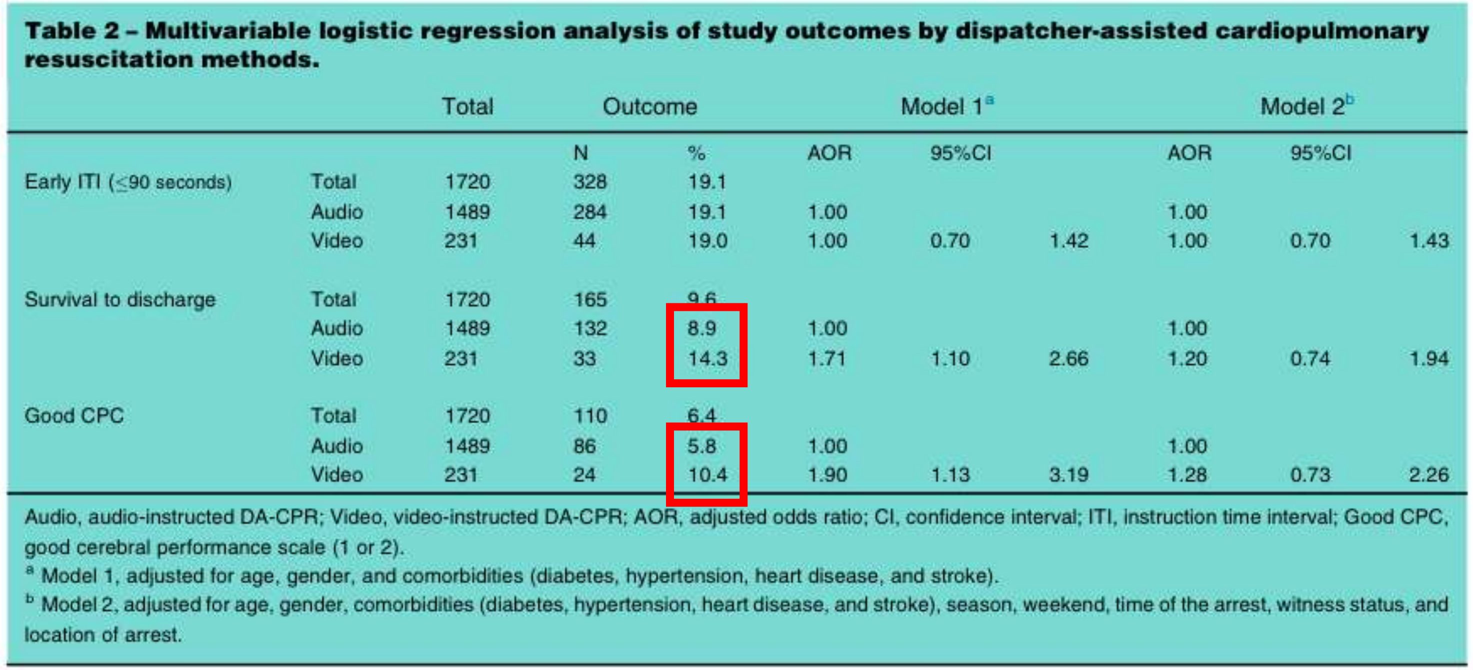


Table 2 – Multivariable logistic regression analysis of study outcomes by dispatcher-assisted cardiopulmonary resuscitation methods.

		Total	Outcome		Model 1[a]			Model 2[b]		
			N	%	AOR	95%CI		AOR	95%CI	
Early ITI (≤90 seconds)	Total	1720	328	19.1						
	Audio	1489	284	19.1	1.00			1.00		
	Video	231	44	19.0	1.00	0.70	1.42	1.00	0.70	1.43
Survival to discharge	Total	1720	165	9.6						
	Audio	1489	132	8.9	1.00			1.00		
	Video	231	33	14.3	1.71	1.10	2.66	1.20	0.74	1.94
Good CPC	Total	1720	110	6.4						
	Audio	1489	86	5.8	1.00			1.00		
	Video	231	24	10.4	1.90	1.13	3.19	1.28	0.73	2.26

Audio, audio-instructed DA-CPR; Video, video-instructed DA-CPR; AOR, adjusted odds ratio; CI, confidence interval; ITI, instruction time interval; Good CPC, good cerebral performance scale (1 or 2).

[a] Model 1, adjusted for age, gender, and comorbidities (diabetes, hypertension, heart disease, and stroke).

[b] Model 2, adjusted for age, gender, comorbidities (diabetes, hypertension, heart disease, and stroke), season, weekend, time of the arrest, witness status, and location of arrest.

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Managing hemodynamically unstable patients usually requires *individualized* interventions, treatments, and drug dosing toward individual patient physiology.

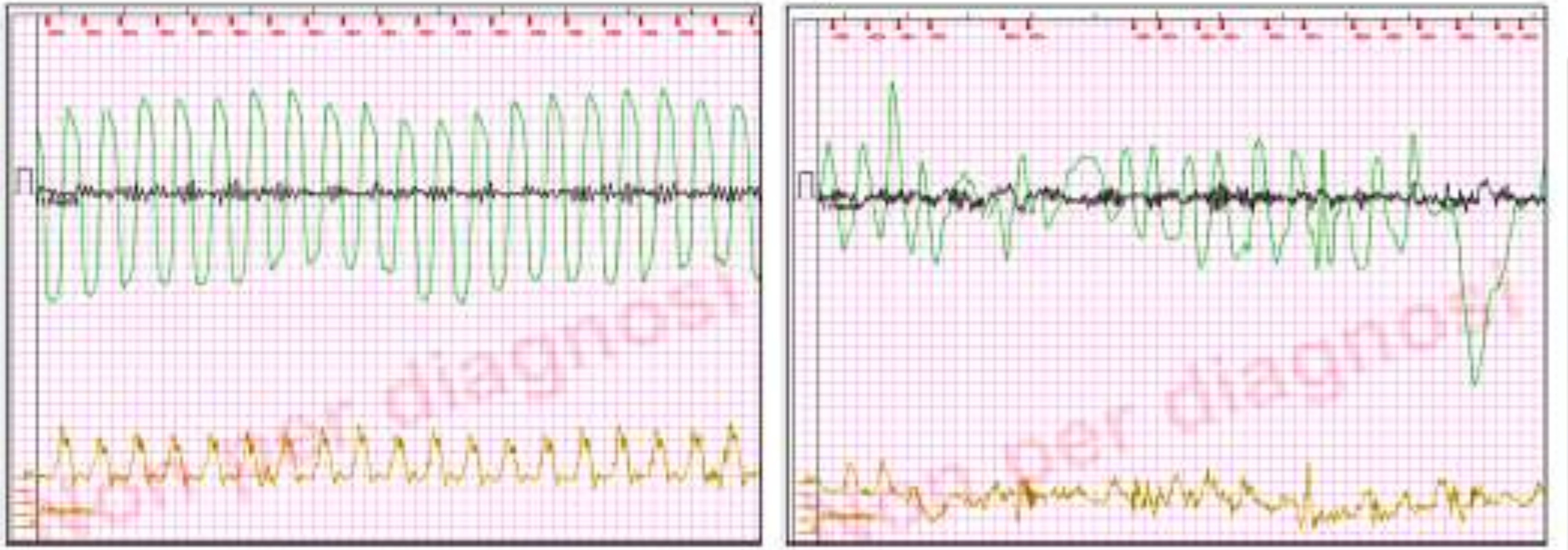
An approach is a titrated and individualized effort to optimize myocardial and cerebral perfusion using dynamic intra-arrest adjustments to the standard CPR-algorithm

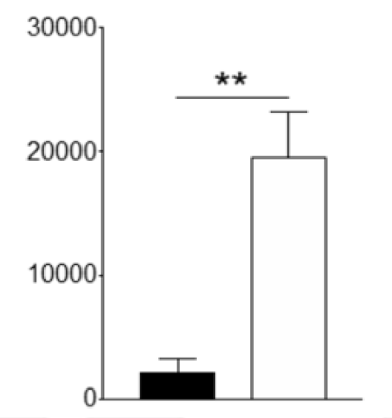
[redacted]

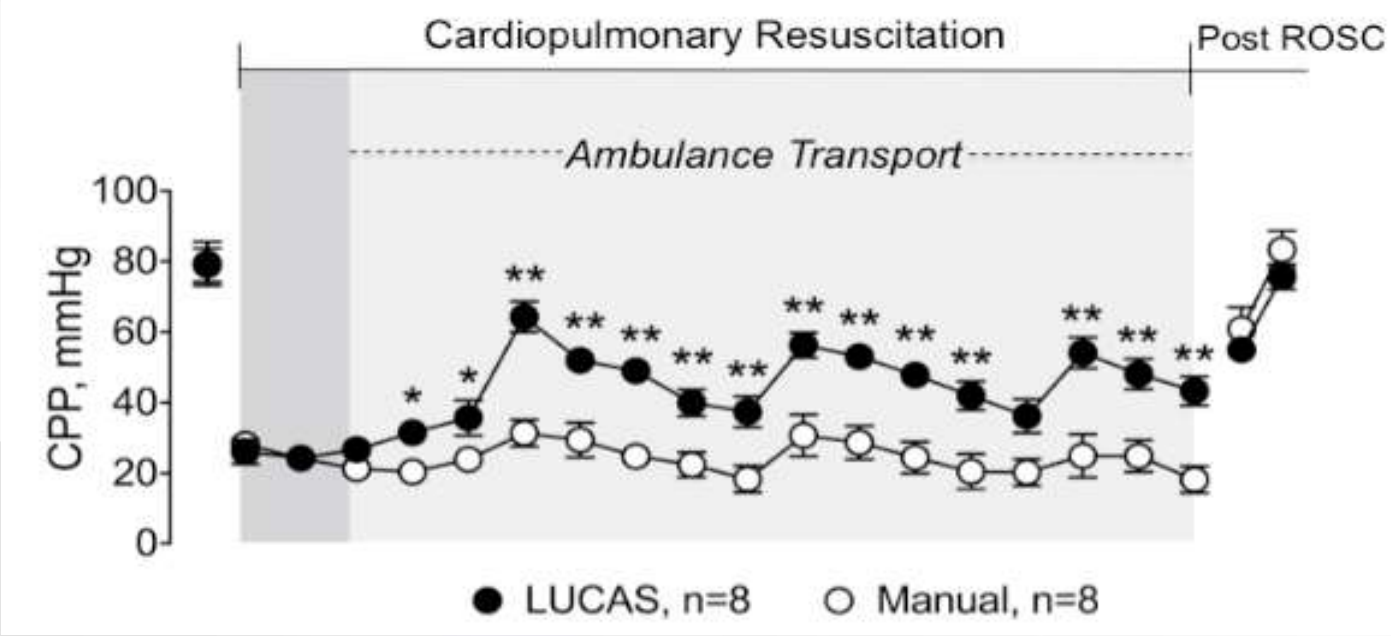
Transport

Mechanical CC

Manual CC







MILANO-MONZA AREU

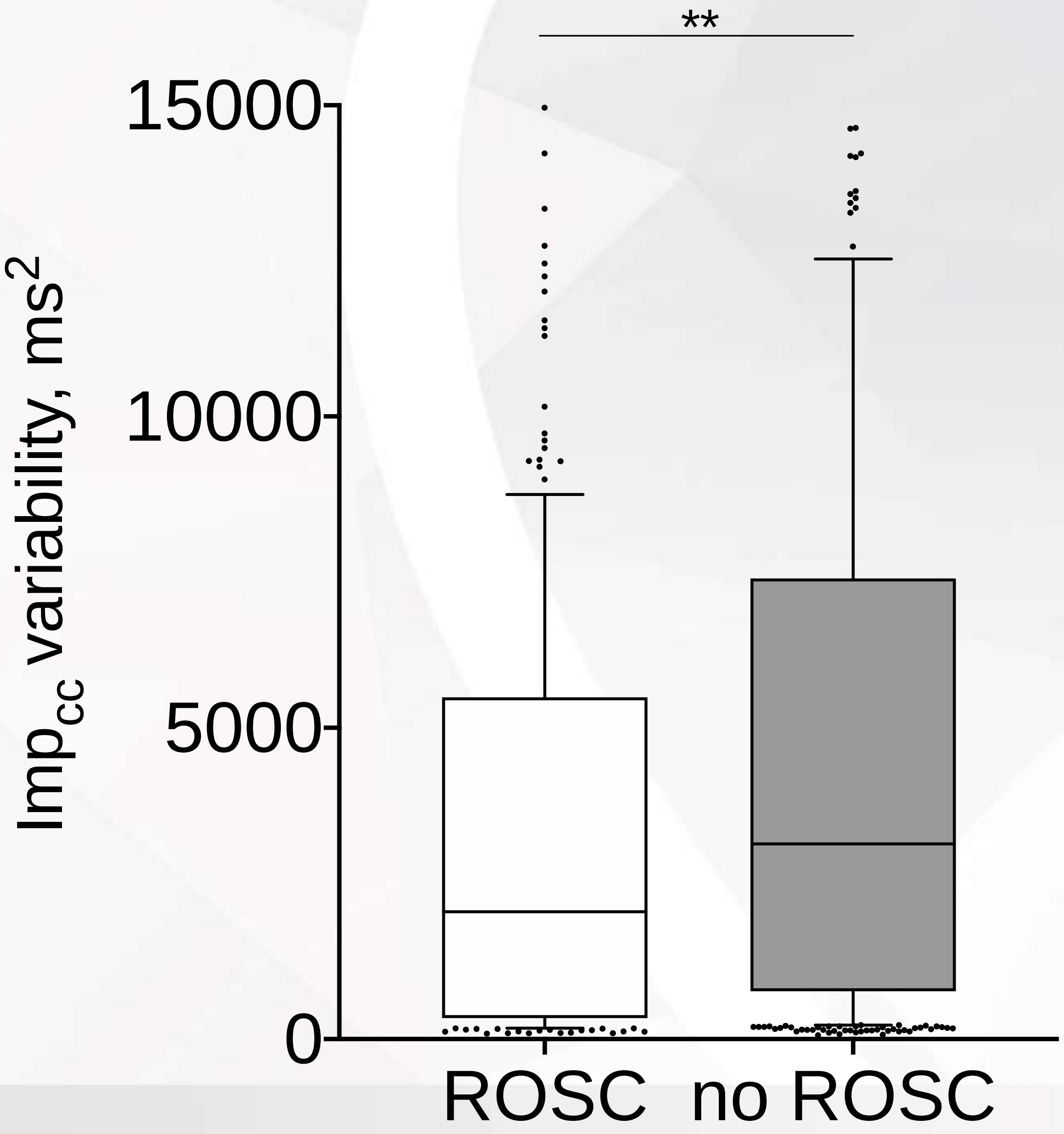
835 PhysioControl DAE recorded cardiac arrest events with VF as initial rhythm

96 Unavailable recordings

51 Excluded

23 No resuscitation maneuvers attempted
20 Resuscitation recordings lasted less than 1 minute
8 Recording artifacts

688 Analysed events


**
15000
10000
5000
0
Imp_{cc} variability, ms^2
ROSC
no ROSC

**p<0.001

Table 2. Relation between Imp_{CC} and CCF with ROSC

	β	***P* value**
Imp_{CC}, ms^2	-7,123e-005	0.0003
CCF, %	0.0167	0.02

CCF=chest compression fraction, Imp_{CC}= CC-generated thoracic impedance variability, ROSC=return of spontaneous circulation

Even when delivered accordingly to guidelines,
CPR provides only:

- 10% to 30% of normal blood flow to the heart
- 30% to 40% of normal blood flow to the brain

→ ***deliver the highest-quality CPR possible!***

Meaney et al. Circulation 2013

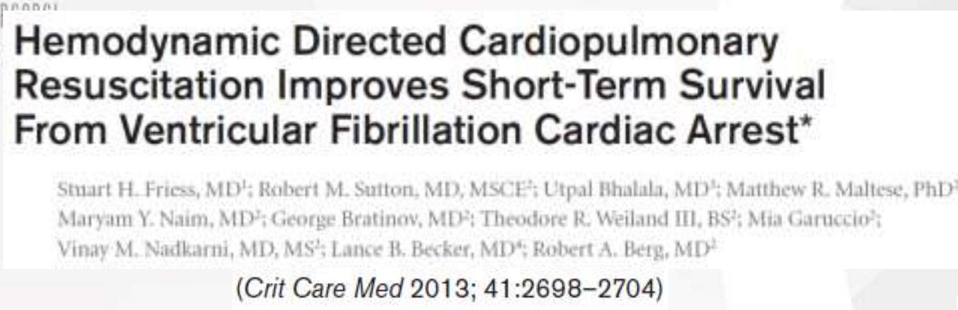
Invasive Monitoring: CPP >20 mmHg

Successful adult resuscitation is more likely when:

- CPP is > 20 mmHg
- Diastolic arterial blood pressure is > 25 to 30 mmHg
- ETCO2 > 10 mmHg (better if > 20 mmHg)

Monitor and titrate CPR

Hemodynamic-Directed CPR



Hemodynamic Directed Cardiopulmonary Resuscitation Improves Short-Term Survival From Ventricular Fibrillation Cardiac Arrest*

Stuart H. Friess, MD[1]; Robert M. Sutton, MD, MSCE[2]; Utpal Bhalala, MD[3]; Matthew R. Maltese, PhD[2]; Maryam Y. Naim, MD[2]; George Bratinov, MD[2]; Theodore R. Weiland III, BS[2]; Mia Garuccio[2]; Vinay M. Nadkarni, MD, MS[2]; Lance B. Becker, MD[4]; Robert A. Berg, MD[2]

(*Crit Care Med* 2013; 41:2698–2704)

Resuscitation. 2014 September ; 85(9): 1298–1303. doi:10.1016/j.resuscitation.2014.05.040.

Hemodynamic Directed CPR Improves Cerebral Perfusion Pressure and Brain Tissue Oxygenation

Stuart H. Friess, MD[1], **Robert M. Sutton, MD MSCE**[2], **Benjamin French, PhD**[3], **Utpal Bhalala, MD**[4], **Matthew R. Maltese, PhD**[2], **Maryam Y. Naim, MD**[2], **George Bratinov, MD**[2], **Silvana Arciniegas Rodriguez, MD**[2], **Theodore R. Weiland III, BS**[2], **Mia Garuccio**[2], **Vinay M. Nadkarni, MD MS**[2], **Lance B. Becker, MD**[5], and **Robert A. Berg, MD**[2]

Resuscitation. 2013 May ; 84(5): 696–701. doi:10.1016/j.resuscitation.2012.10.023.

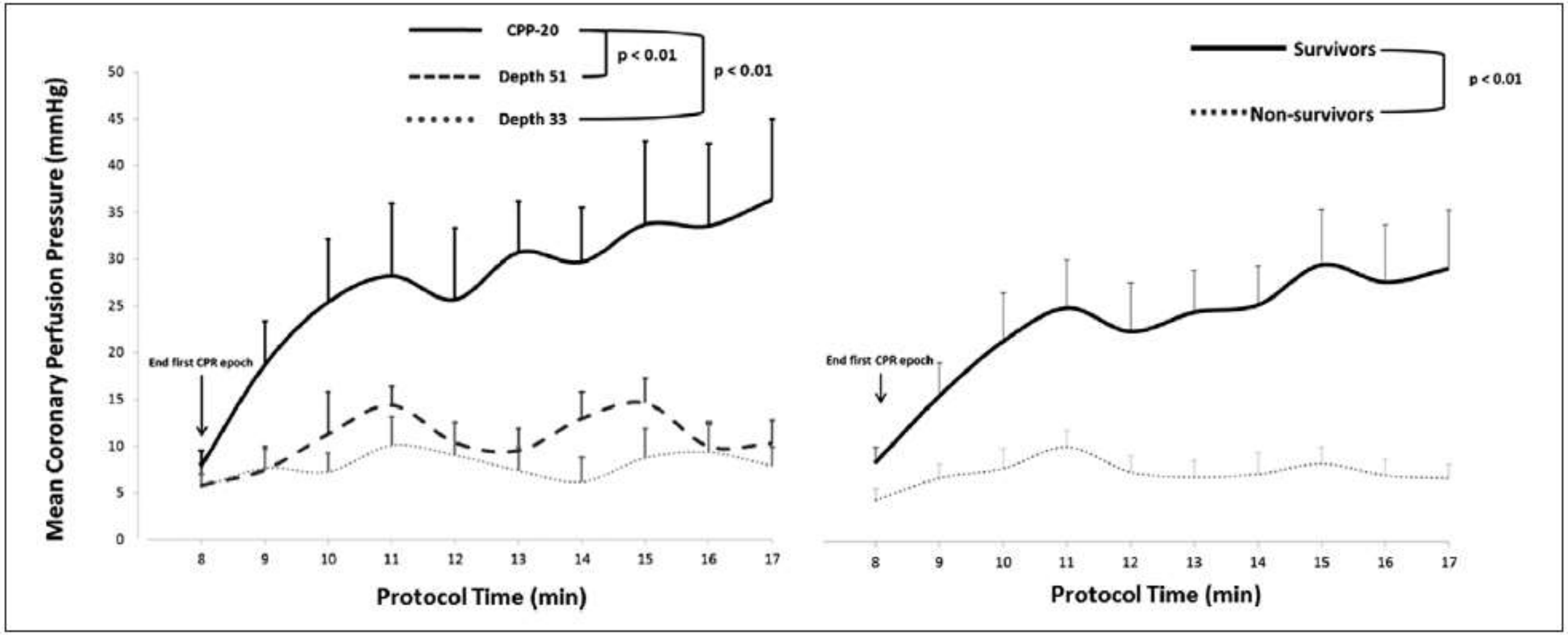
Hemodynamic Directed CPR Improves Short-term Survival from Asphyxia-Associated Cardiac Arrest

Robert M. Sutton, MD MSCE[1], **Stuart H. Friess, MD**[1], **Utpal Bhalala, MD**[1], **Matthew R. Maltese, PhD**[1], **Maryam Y. Naim, MD**[1], **George Bratinov, MD**[1], **Dana Niles, MS**[1], **Vinay M. Nadkarni, MD MS**[1], **Lance B. Becker, MD**[2], and **Robert A. Berg, MD**[1]

Resuscitation. 2014 August ; 85(8): 983–986. doi:10.1016/j.resuscitation.2014.04.015.

Hemodynamic–directed cardiopulmonary resuscitation during in–hospital cardiac arrest*

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

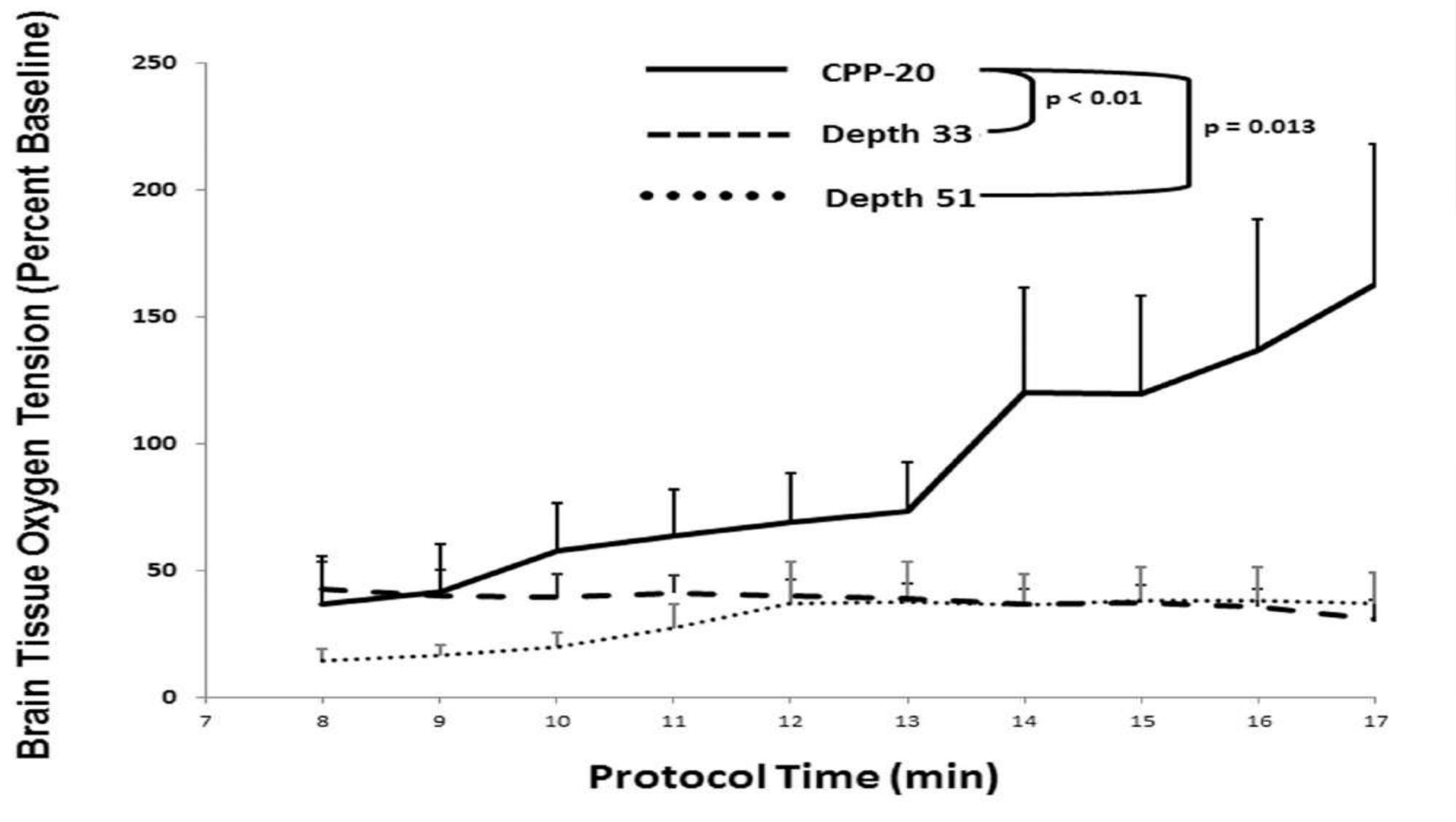


	Depth 33 (*n* = 8)	Depth 51 (*n* = 8)	Coronary Perfusion Pressure-20 (*n* = 8)	*p*
Survival [*n* (%)]				
Any return of spontaneous circulation	1 (13)	3 (38)	8 (100)	0.002
45-min ICU survival	1 (13)	3 (38)	8 (100)	0.002

Resuscitation. 2014 September ; 85(9): 1298–1303. doi:10.1016/j.resuscitation.2014.05.040.

Hemodynamic Directed CPR Improves Cerebral Perfusion Pressure and Brain Tissue Oxygenation

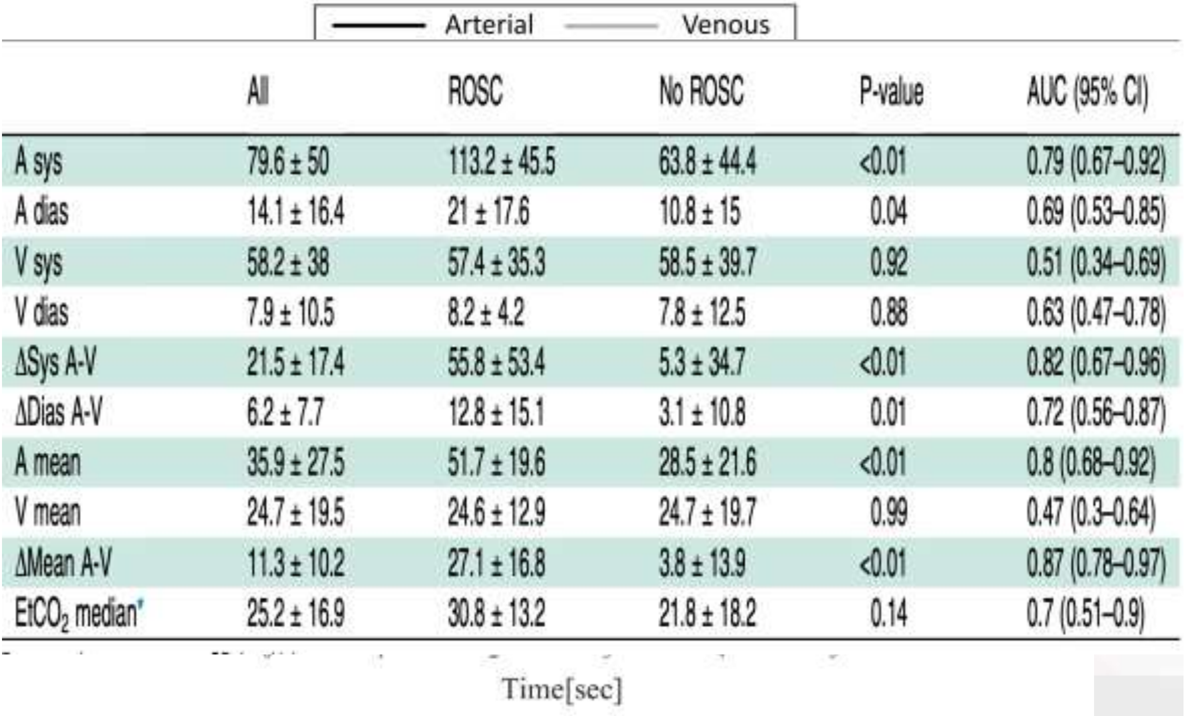
Stuart H. Friess, MD[1], Robert M. Sutton, MD MSCE[2], Benjamin French, PhD[3], Utpal Bhalala, MD[4], Matthew R. Maltese, PhD[2], Maryam Y. Naim, MD[2], George Bratinov, MD[2], Silvana Arciniegas Rodriguez, MD[2], Theodore R. Weiland III, BS[2], Mia Garuccio[2], Vinay M. Nadkarni, MD MS[2], Lance B. Becker, MD[5], and Robert A. Berg, MD[2]



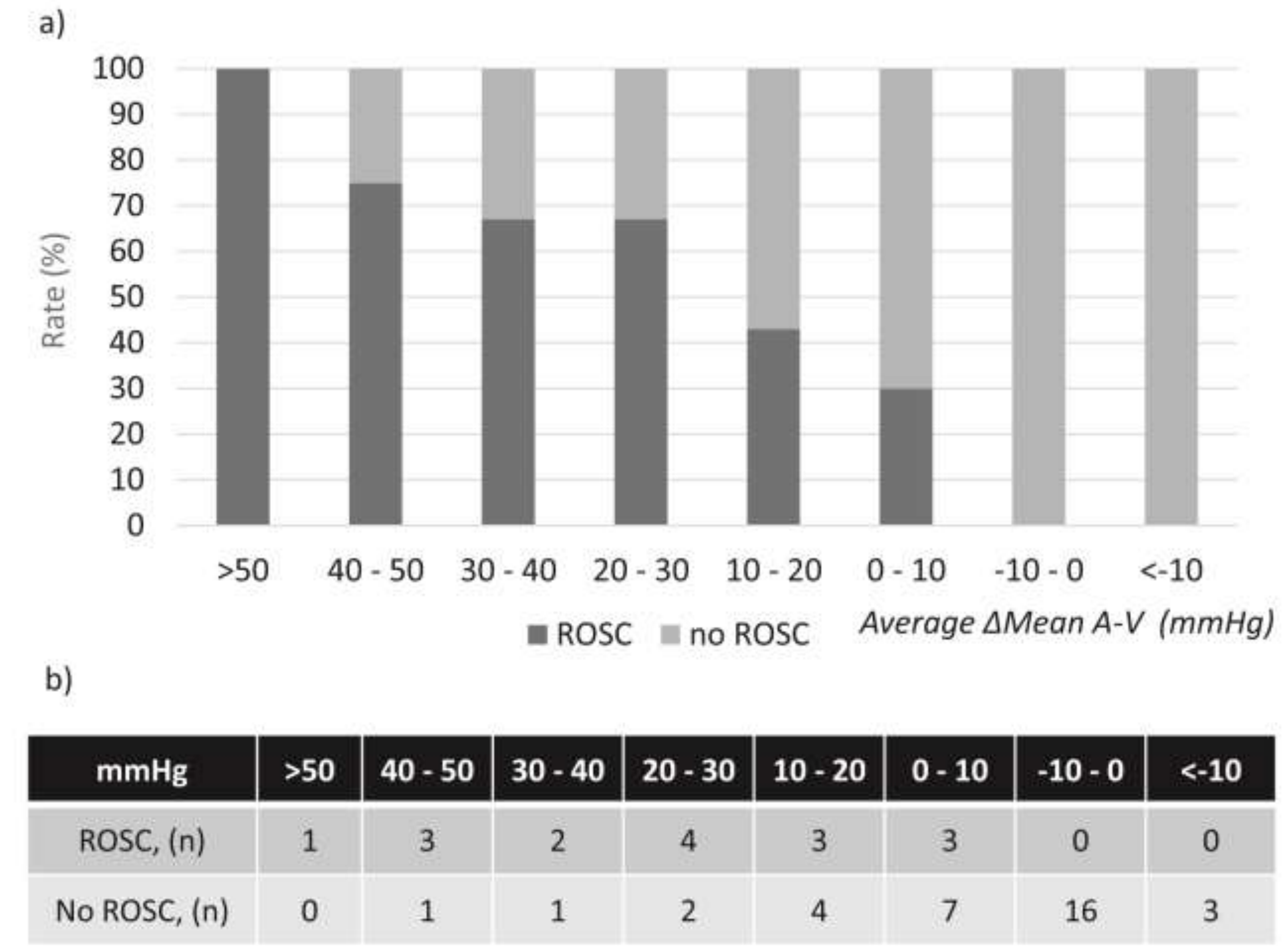
Clinical paper

Association between haemodynamics during cardiopulmonary resuscitation and patient outcomes

50 patients

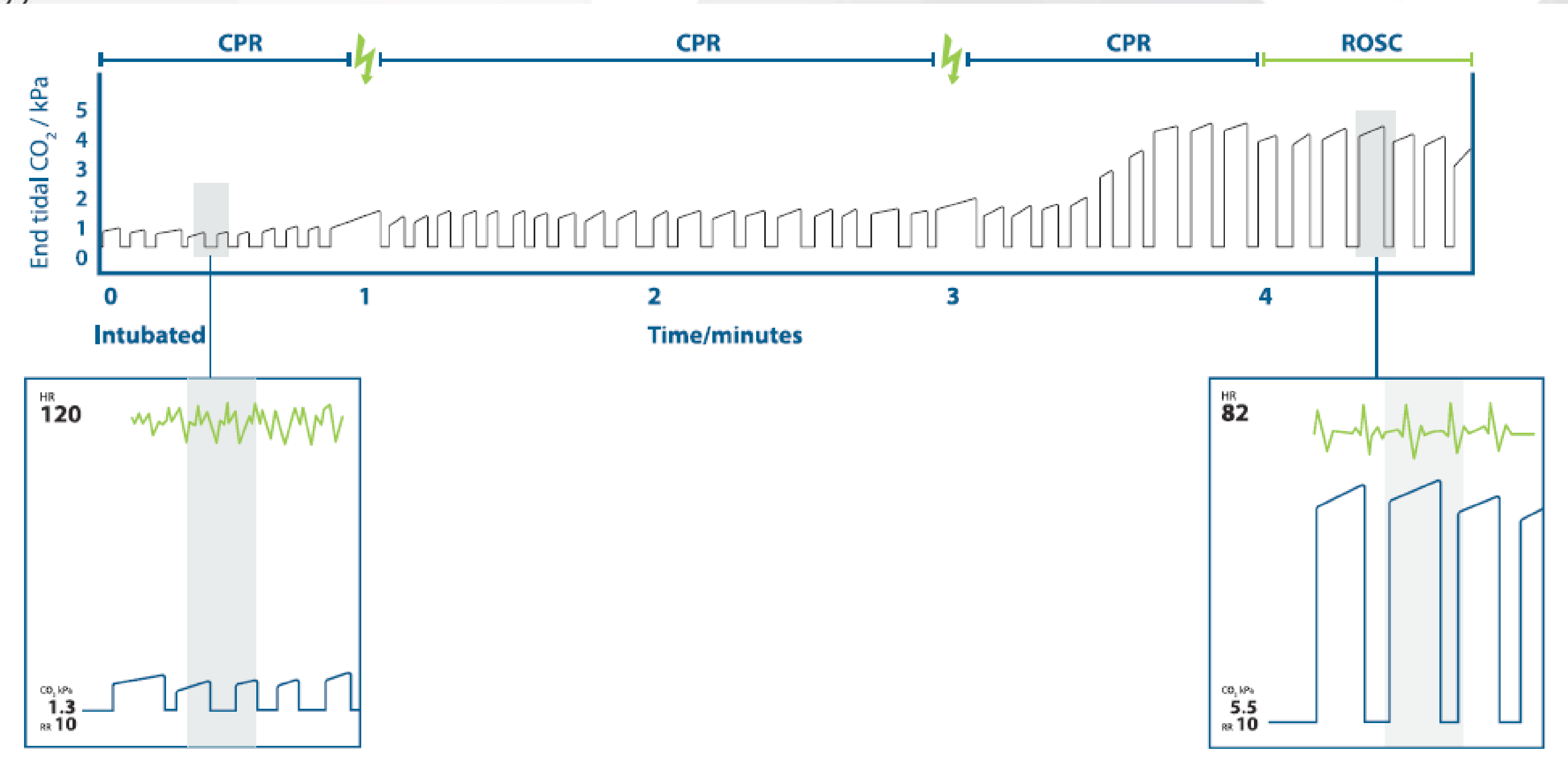


	All	ROSC	No ROSC	P-value	AUC (95% CI)
A sys	79.6 ± 50	113.2 ± 45.5	63.8 ± 44.4	<0.01	0.79 (0.67–0.92)
A dias	14.1 ± 16.4	21 ± 17.6	10.8 ± 15	0.04	0.69 (0.53–0.85)
V sys	58.2 ± 38	57.4 ± 35.3	58.5 ± 39.7	0.92	0.51 (0.34–0.69)
V dias	7.9 ± 10.5	8.2 ± 4.2	7.8 ± 12.5	0.88	0.63 (0.47–0.78)
ΔSys A-V	21.5 ± 17.4	55.8 ± 53.4	5.3 ± 34.7	<0.01	0.82 (0.67–0.96)
ΔDias A-V	6.2 ± 7.7	12.8 ± 15.1	3.1 ± 10.8	0.01	0.72 (0.56–0.87)
A mean	35.9 ± 27.5	51.7 ± 19.6	28.5 ± 21.6	<0.01	0.8 (0.68–0.92)
V mean	24.7 ± 19.5	24.6 ± 12.9	24.7 ± 19.7	0.99	0.47 (0.3–0.64)
ΔMean A-V	11.3 ± 10.2	27.1 ± 16.8	3.8 ± 13.9	<0.01	0.87 (0.78–0.97)
$EtCO_2$ median*	25.2 ± 16.9	30.8 ± 13.2	21.8 ± 18.2	0.14	0.7 (0.51–0.9)

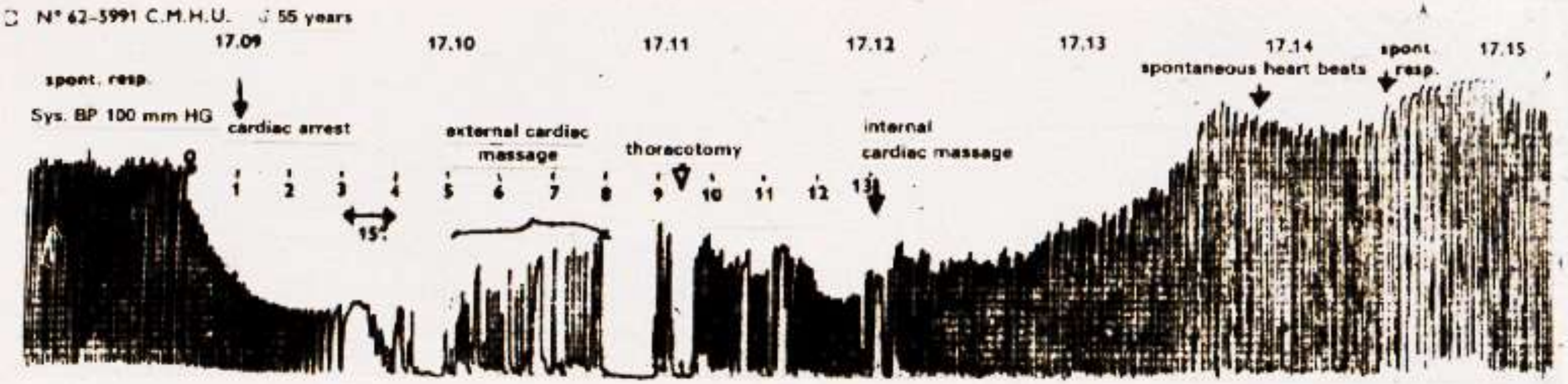


mmHg	>50	40 - 50	30 - 40	20 - 30	10 - 20	0 - 10	-10 - 0	<-10
ROSC, (n)	1	3	2	4	3	3	0	0
No ROSC, (n)	0	1	1	2	4	7	16	3

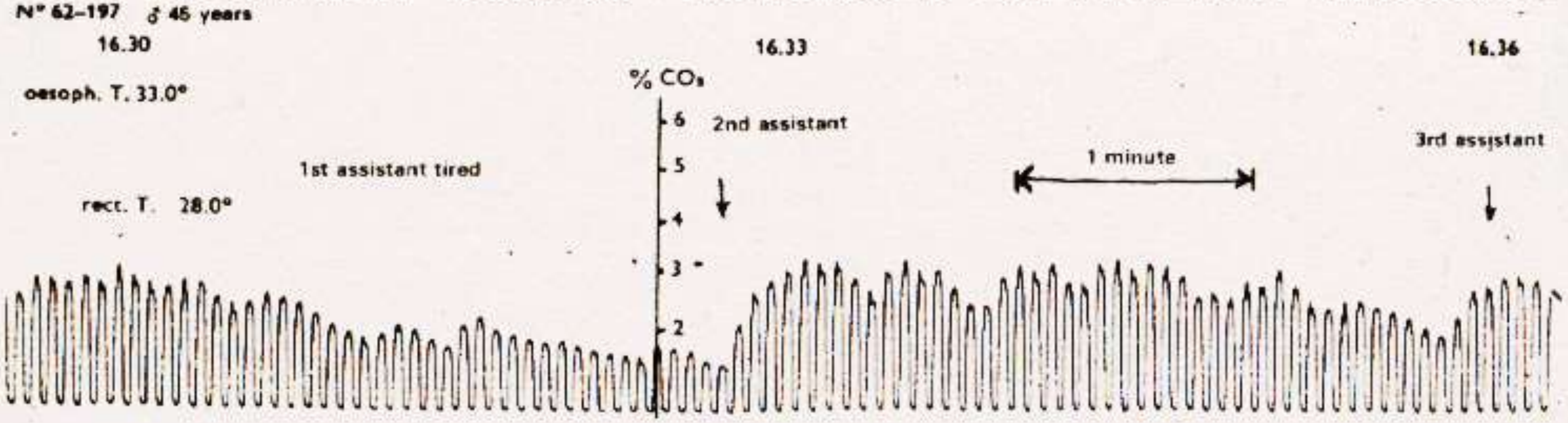
Resuscitation 2022

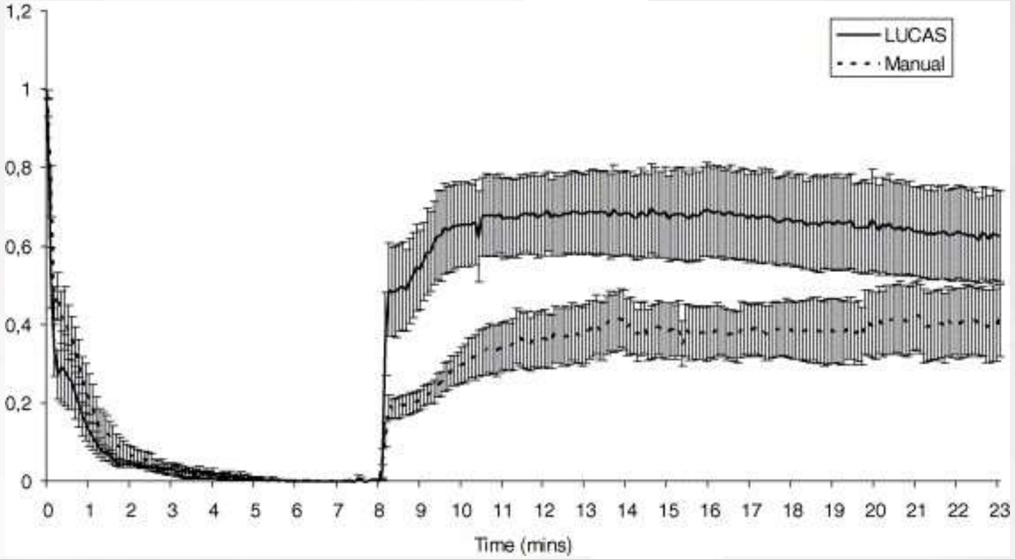

CPR
CPR
CPR
ROSC
End tidal CO2 / kPa
5
4
3
2
1
0
0
1
2
3
4
Intubated
Time/minutes
HR
120
CO2 kPa
1.3
RR 10
HR
82
CO2 kPa
5.5
RR 10

CAPNOGRAPHY DURING CARDIAC ARREST

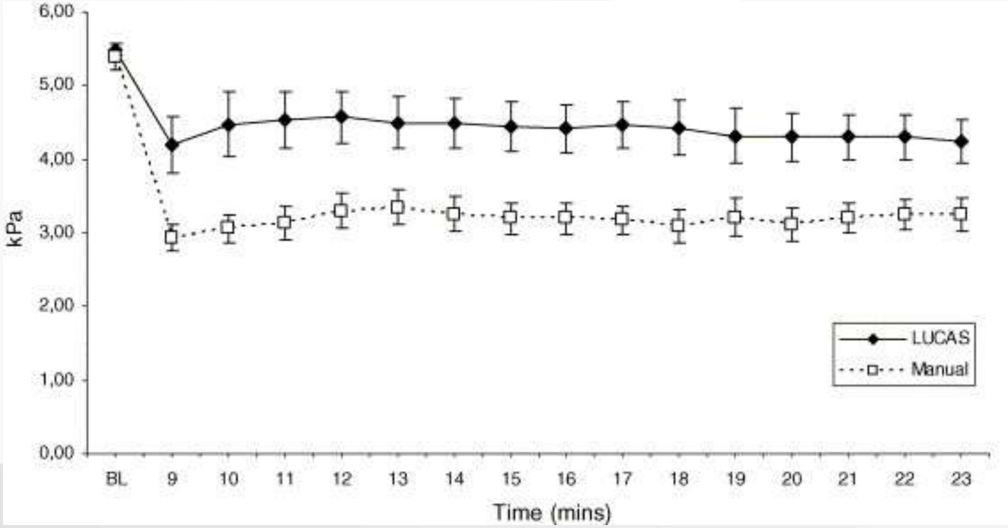


CAPNOGRAPHY DURING PROLONGED OPEN HEART MASSAGE





Cerebral blood flow



End tidal CO2

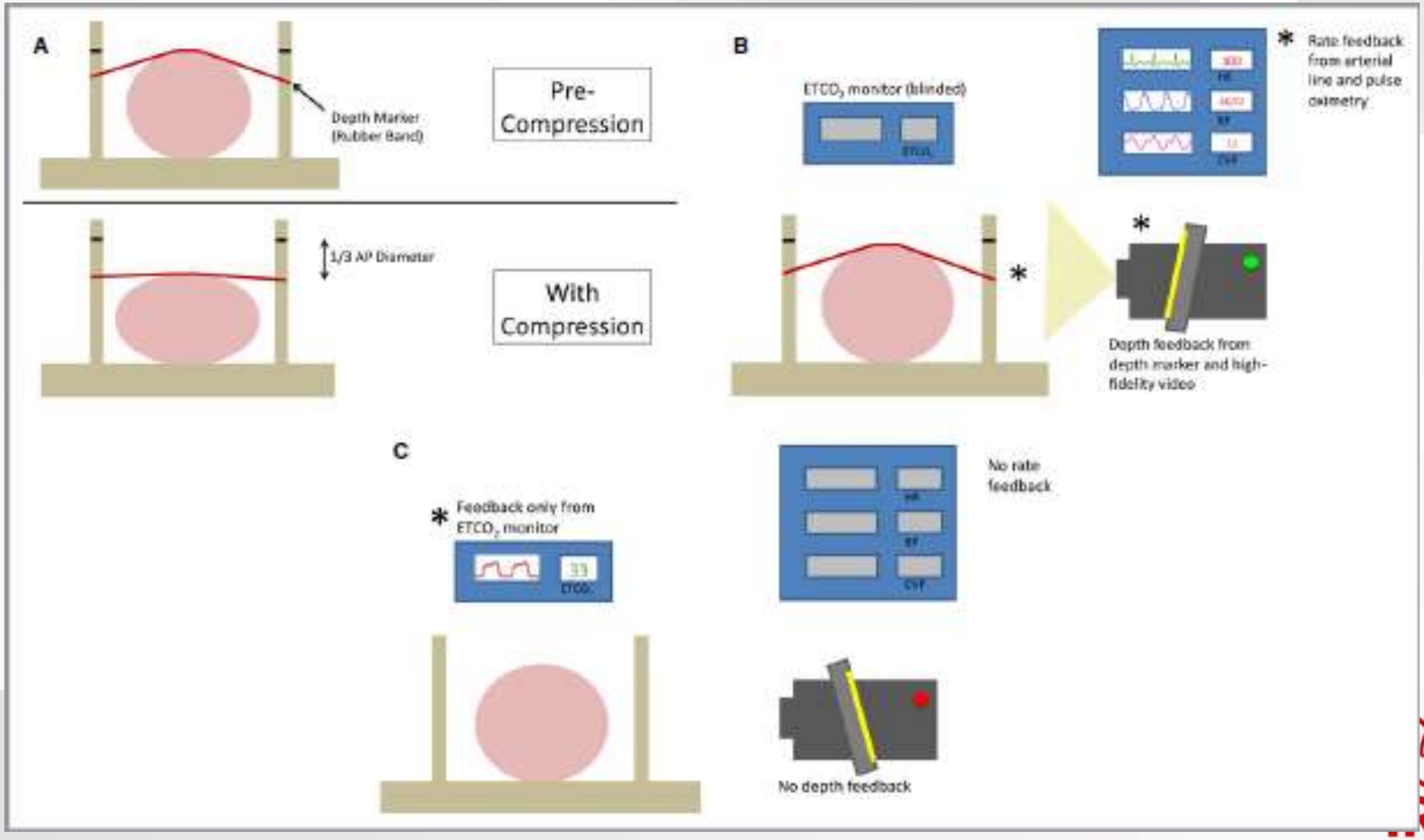
Rubertsson et al Resuscitation 2005

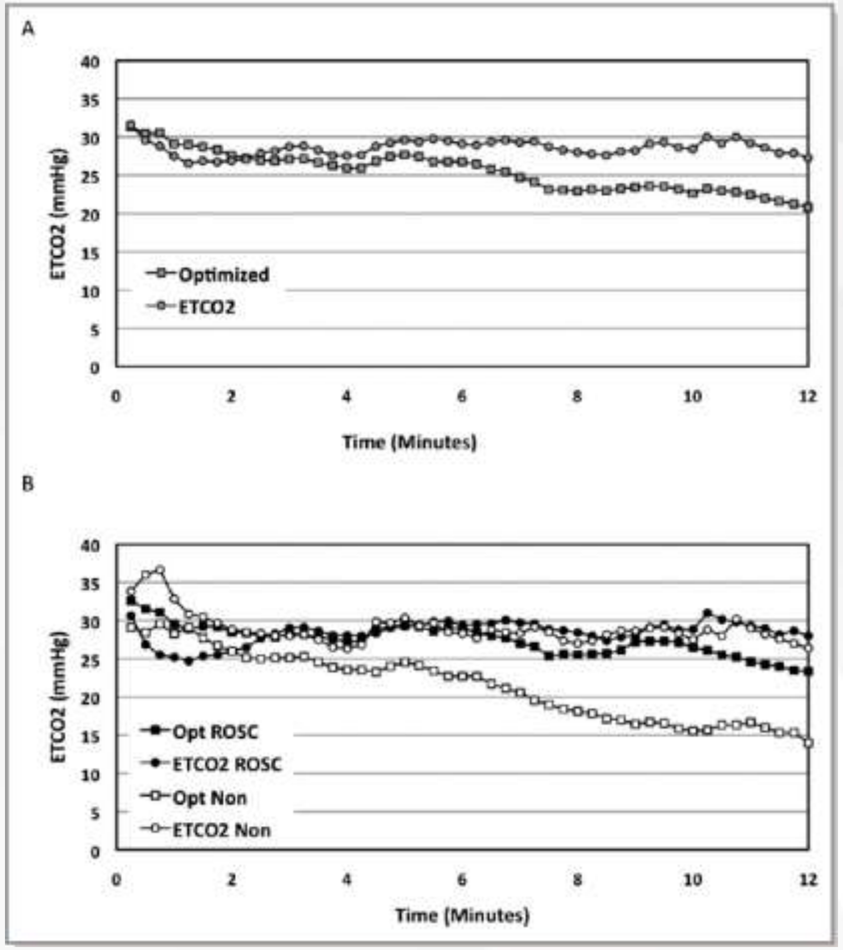
$EtCO_2$-directed CPR

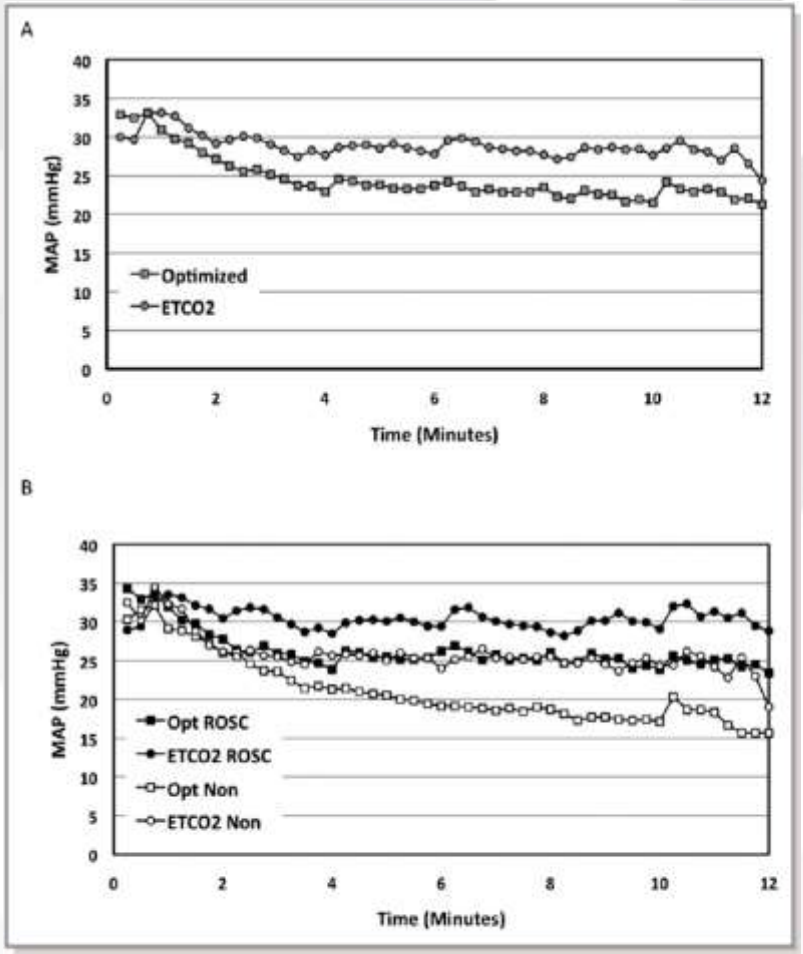
Efficacy of Chest Compressions Directed by End-Tidal CO_2 Feedback in a Pediatric Resuscitation Model of Basic Life Support

Jennifer L. Hamrick, MD; Justin T. Hamrick, MD; Jennifer K. Lee, MD; Benjamin H. Lee, MD; Raymond C. Koehler, PhD; Donald H. Shaffner, MD

JAHA 2014







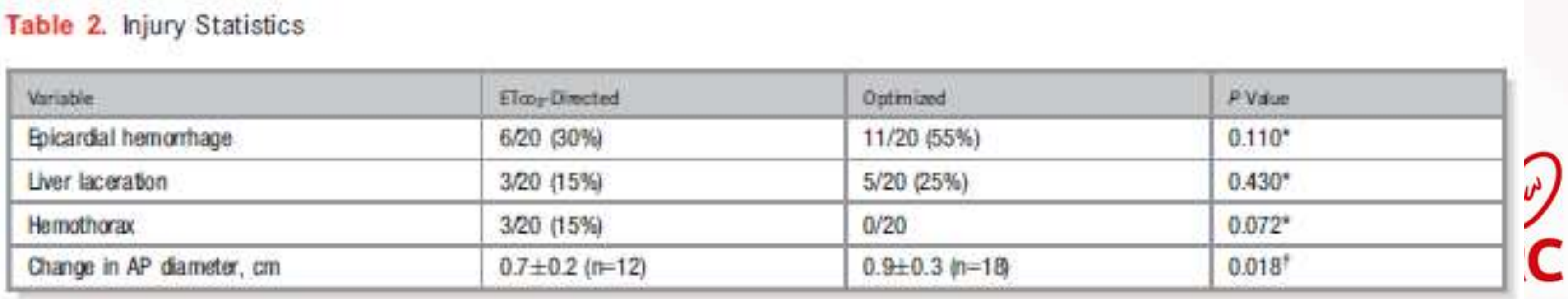
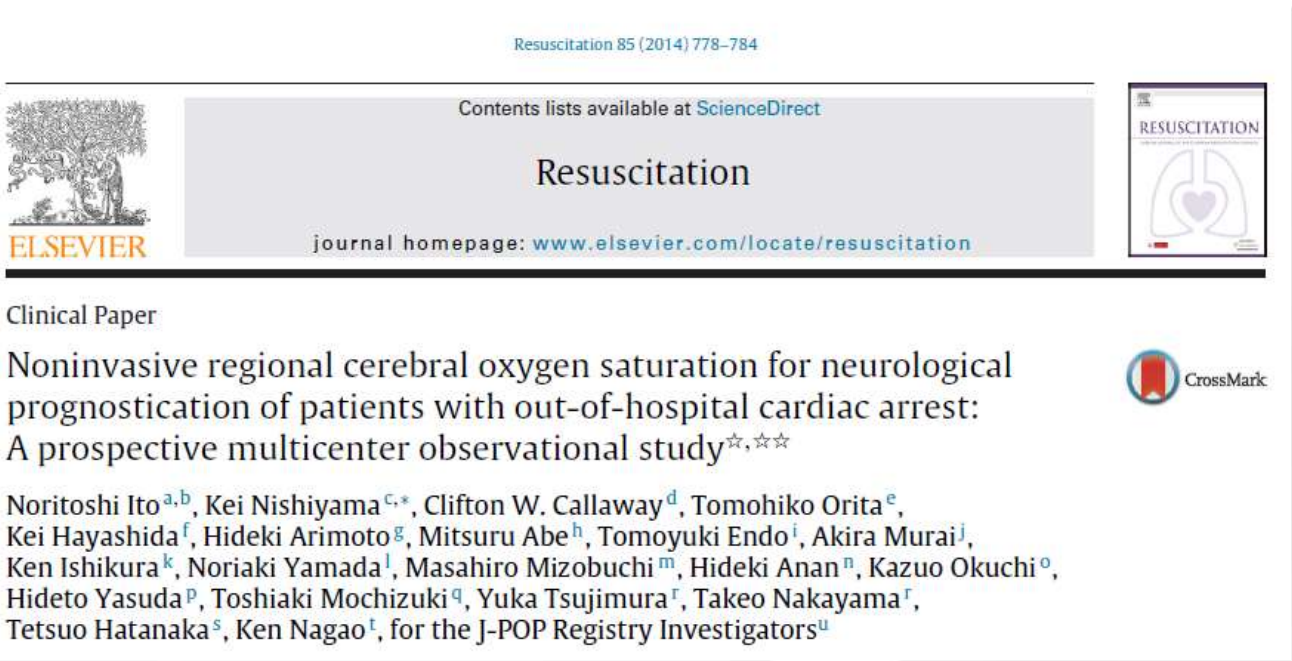


Table 2. Injury Statistics

Variable	ETco$_2$-Directed	Optimized	P Value
Epicardial hemorrhage	6/20 (30%)	11/20 (55%)	0.110*
Liver laceration	3/20 (15%)	5/20 (25%)	0.430*
Hemothorax	3/20 (15%)	0/20	0.072*
Change in AP diameter, cm	0.7±0.2 (n=12)	0.9±0.3 (n=18)	0.018†

Regional cerebral oxymetry rSO_2 Near Infrared Spectroscopy NIRS



Resuscitation 85 (2014) 778–784

Contents lists available at ScienceDirect

Resuscitation

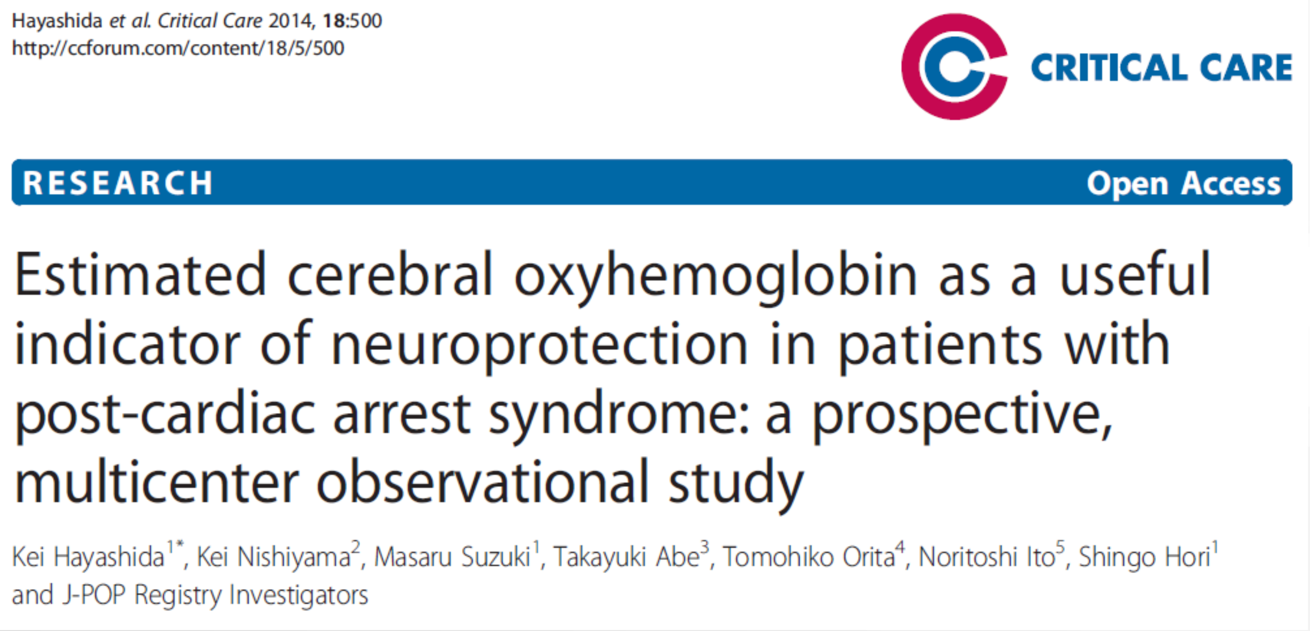
journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

Noninvasive regional cerebral oxygen saturation for neurological prognostication of patients with out-of-hospital cardiac arrest: A prospective multicenter observational study☆,☆☆

Noritoshi Ito[a,b], Kei Nishiyama[c,*], Clifton W. Callaway[d], Tomohiko Orita[e], Kei Hayashida[f], Hideki Arimoto[g], Mitsuru Abe[h], Tomoyuki Endo[i], Akira Murai[j], Ken Ishikura[k], Noriaki Yamada[l], Masahiro Mizobuchi[m], Hideki Anan[n], Kazuo Okuchi[o], Hideto Yasuda[p], Toshiaki Mochizuki[q], Yuka Tsujimura[r], Takeo Nakayama[r], Tetsuo Hatanaka[s], Ken Nagao[t], for the J-POP Registry Investigators[u]

672 patients



Hayashida et al. Critical Care 2014, 18:500
http://ccforum.com/content/18/5/500

CRITICAL CARE

RESEARCH **Open Access**

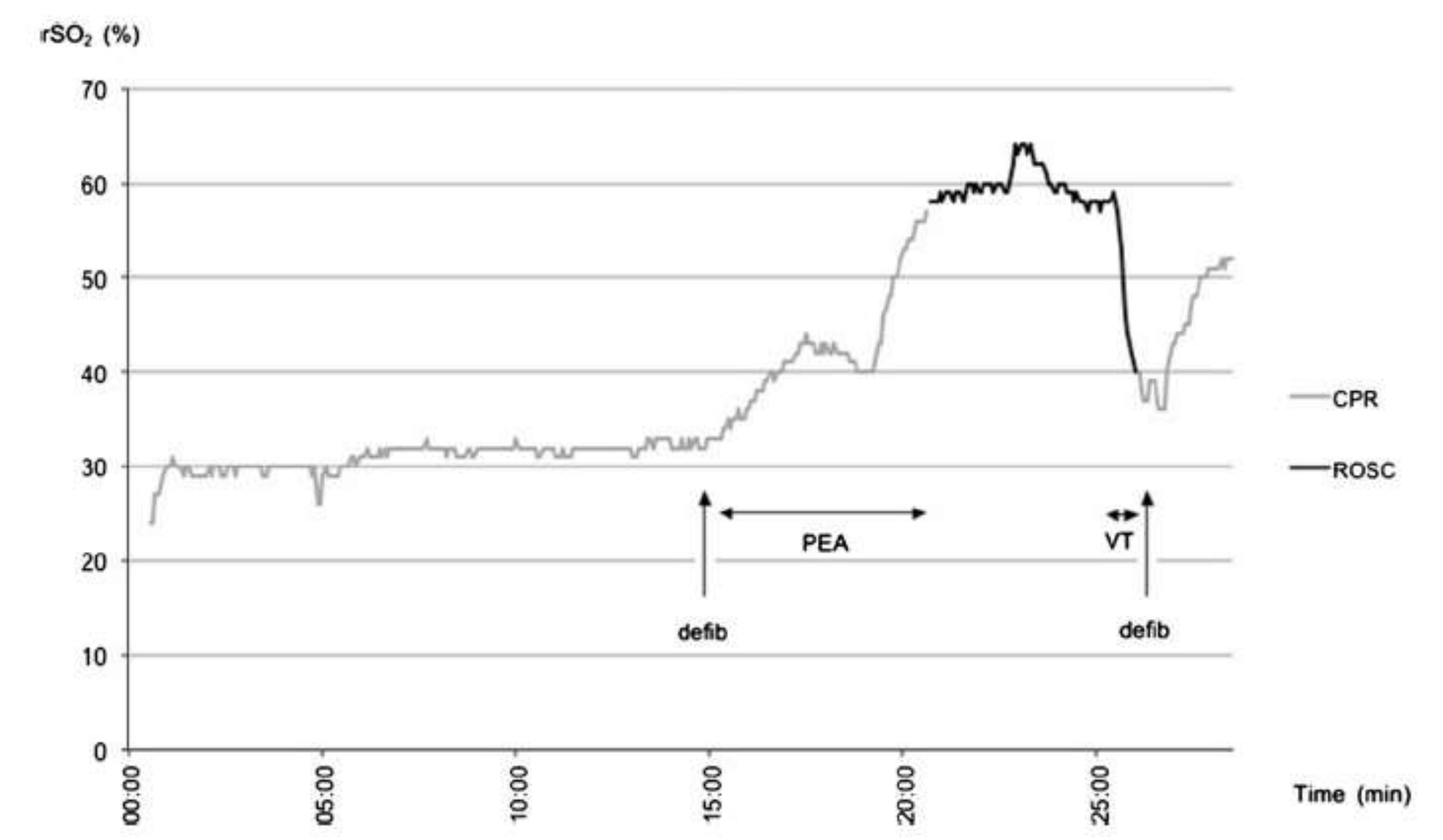
Estimated cerebral oxyhemoglobin as a useful indicator of neuroprotection in patients with post-cardiac arrest syndrome: a prospective, multicenter observational study

Kei Hayashida[1*], Kei Nishiyama[2], Masaru Suzuki[1], Takayuki Abe[3], Tomohiko Orita[4], Noritoshi Ito[5], Shingo Hori[1] and J-POP Registry Investigators

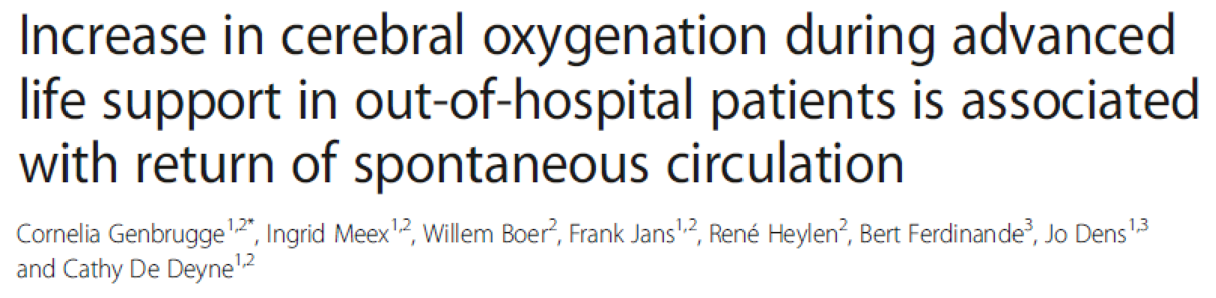
492 patients

Monitoring of cerebral oxygen saturation during resuscitation in out-of-hospital cardiac arrest: a feasibility study in a physician staffed emergency medical system

10 patients were prospectively enrolled.



Schewe *et al. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2014, **22**:58

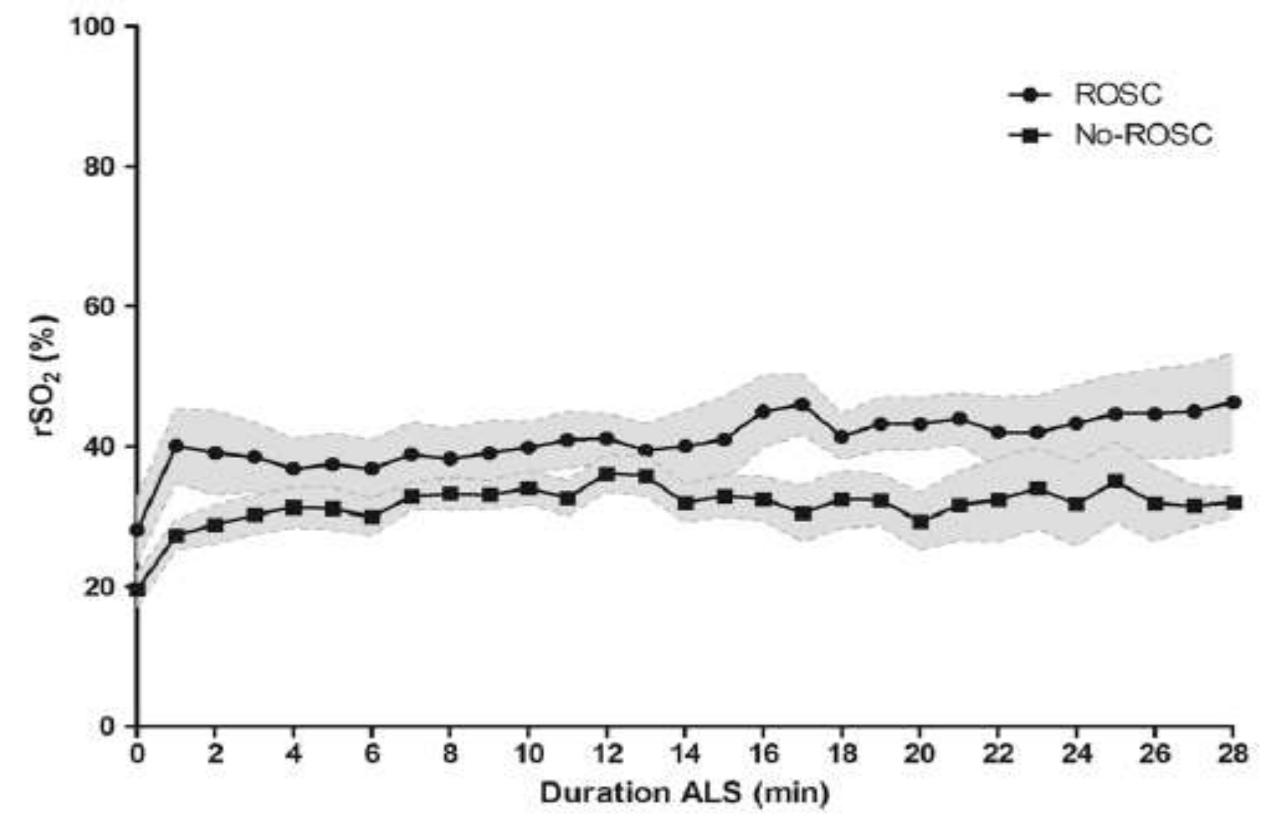


Increase in cerebral oxygenation during advanced life support in out-of-hospital patients is associated with return of spontaneous circulation

Cornelia Genbrugge[1,2*], Ingrid Meex[1,2], Willem Boer[2], Frank Jans[1,2], René Heylen[2], Bert Ferdinande[3], Jo Dens[1,3] and Cathy De Deyne[1,2]

Crit Care
2015

49 OHCAs

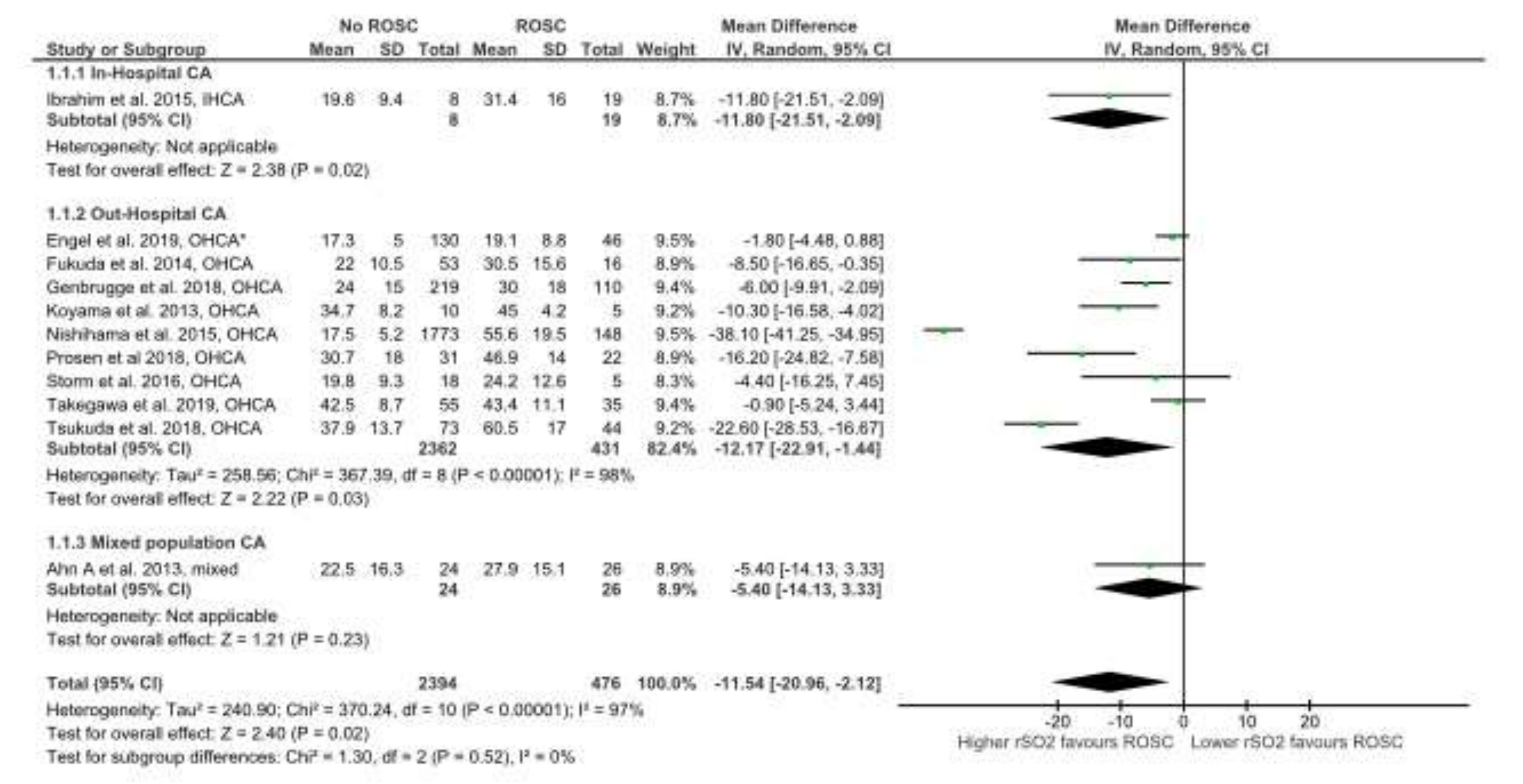


During ALS, higher rSO2 were observed in patients who achieved ROSC compared to those who did not

Clinical paper

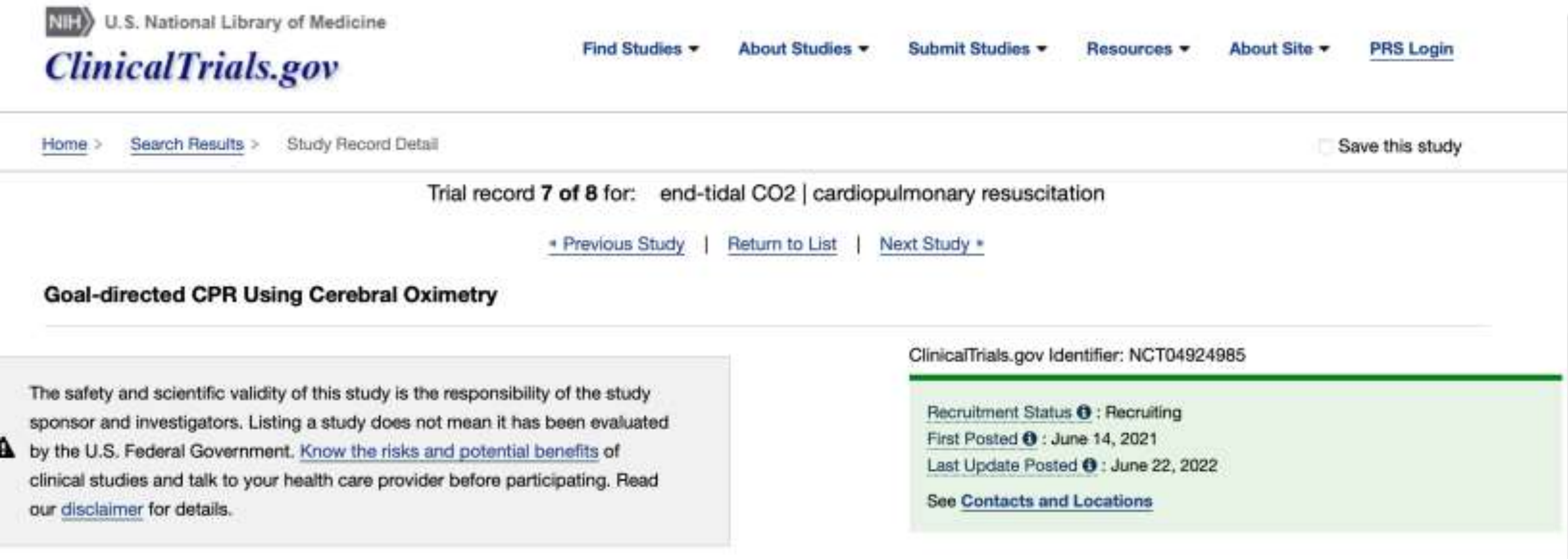
Cerebral regional oxygen saturation during cardiopulmonary resuscitation and return of spontaneous circulation: A systematic review and meta-analysis

Filippo Sanfilippo [a,], Paolo Murabito [a,b,c], Antonio Messina [d,e], Veronica Dezio [c], Diana Busalacchi [c], Giuseppe Ristagno [f,g], Maurizio Cecconi [d,e], Marinella Astuto [a,b,c]*



	No ROSC			ROSC				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Random, 95% CI**
1.1.1 In-Hospital CA								
Ibrahim et al. 2015, IHCA	19.6	9.4	8	31.4	16	19	8.7%	-11.80 [-21.51, -2.09]
Subtotal (95% CI)			**8**			**19**	**8.7%**	**-11.80 [-21.51, -2.09]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.38 (P = 0.02)								
1.1.2 Out-Hospital CA								
Engel et al. 2019, OHCA*	17.3	5	130	19.1	8.8	46	9.5%	-1.80 [-4.48, 0.88]
Fukuda et al. 2014, OHCA	22	10.5	53	30.5	15.6	16	8.9%	-8.50 [-16.65, -0.35]
Genbrugge et al. 2018, OHCA	24	15	219	30	18	110	9.4%	-6.00 [-9.91, -2.09]
Koyama et al. 2013, OHCA	34.7	8.2	10	45	4.2	5	9.2%	-10.30 [-16.58, -4.02]
Nishihama et al. 2015, OHCA	17.5	5.2	1773	55.6	19.5	148	9.5%	-38.10 [-41.25, -34.95]
Prosen et al 2018, OHCA	30.7	18	31	46.9	14	22	8.9%	-16.20 [-24.82, -7.58]
Storm et al. 2016, OHCA	19.8	9.3	18	24.2	12.6	5	8.3%	-4.40 [-16.25, 7.45]
Takegawa et al. 2019, OHCA	42.5	8.7	55	43.4	11.1	35	9.4%	-0.90 [-5.24, 3.44]
Tsukuda et al. 2018, OHCA	37.9	13.7	73	60.5	17	44	9.2%	-22.60 [-28.53, -16.67]
Subtotal (95% CI)			**2362**			**431**	**82.4%**	**-12.17 [-22.91, -1.44]**
Heterogeneity: Tau² = 258.56; Chi² = 367.39, df = 8 (P < 0.00001); I² = 98%								
Test for overall effect: Z = 2.22 (P = 0.03)								
1.1.3 Mixed population CA								
Ahn A et al. 2013, mixed	22.5	16.3	24	27.9	15.1	26	8.9%	-5.40 [-14.13, 3.33]
Subtotal (95% CI)			**24**			**26**	**8.9%**	**-5.40 [-14.13, 3.33]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.21 (P = 0.23)								
Total (95% CI)			**2394**			**476**	**100.0%**	**-11.54 [-20.96, -2.12]**
Heterogeneity: Tau² = 240.90; Chi² = 370.24, df = 10 (P < 0.00001); I² = 97%								
Test for overall effect: Z = 2.40 (P = 0.02)								
Test for subgroup differences: Chi² = 1.30, df = 2 (P = 0.52), I² = 0%								

RESUSCITATION 159 (2021) 19 –27



Trial record **7 of 8** for: end-tidal CO2 | cardiopulmonary resuscitation

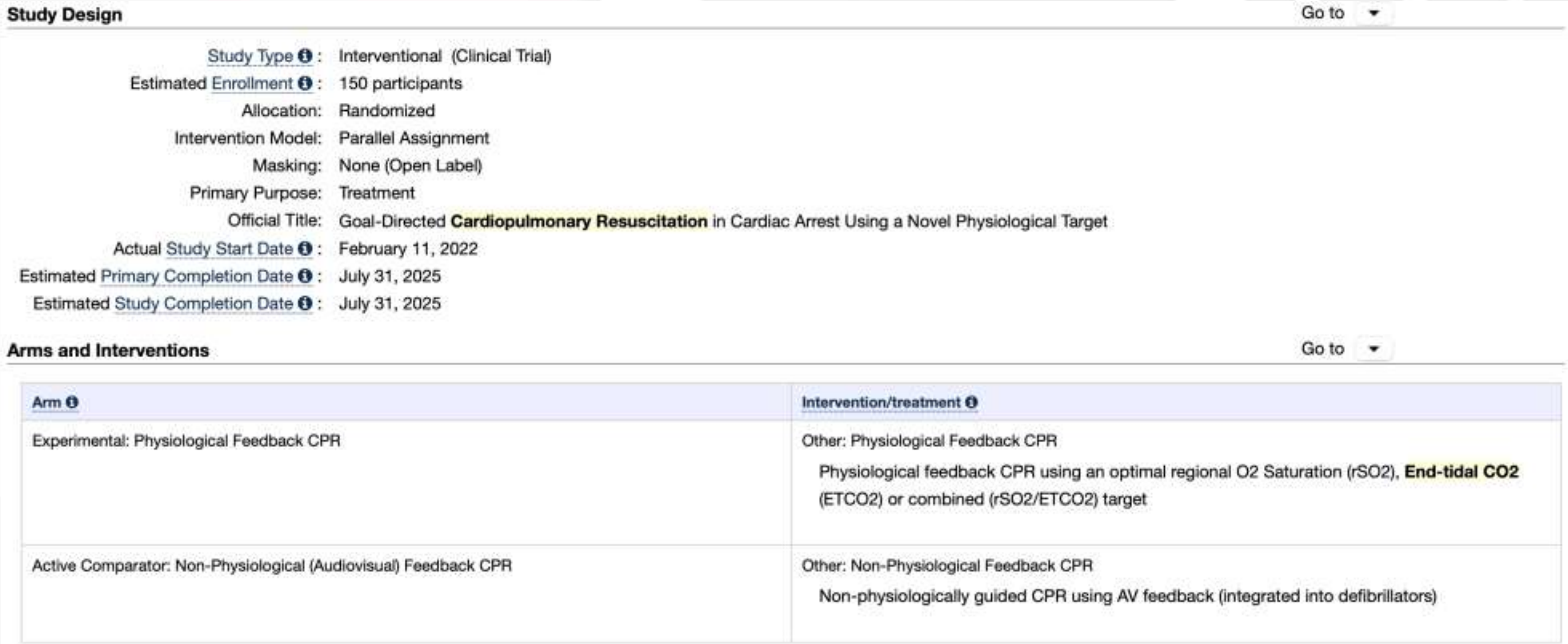
Goal-directed CPR Using Cerebral Oximetry

The safety and scientific validity of this study is the responsibility of the study sponsor and investigators. Listing a study does not mean it has been evaluated by the U.S. Federal Government. Know the risks and potential benefits of clinical studies and talk to your health care provider before participating. Read our disclaimer for details.

ClinicalTrials.gov Identifier: NCT04924985

Recruitment Status : Recruiting
First Posted : June 14, 2021
Last Update Posted : June 22, 2022

See **Contacts and Locations**

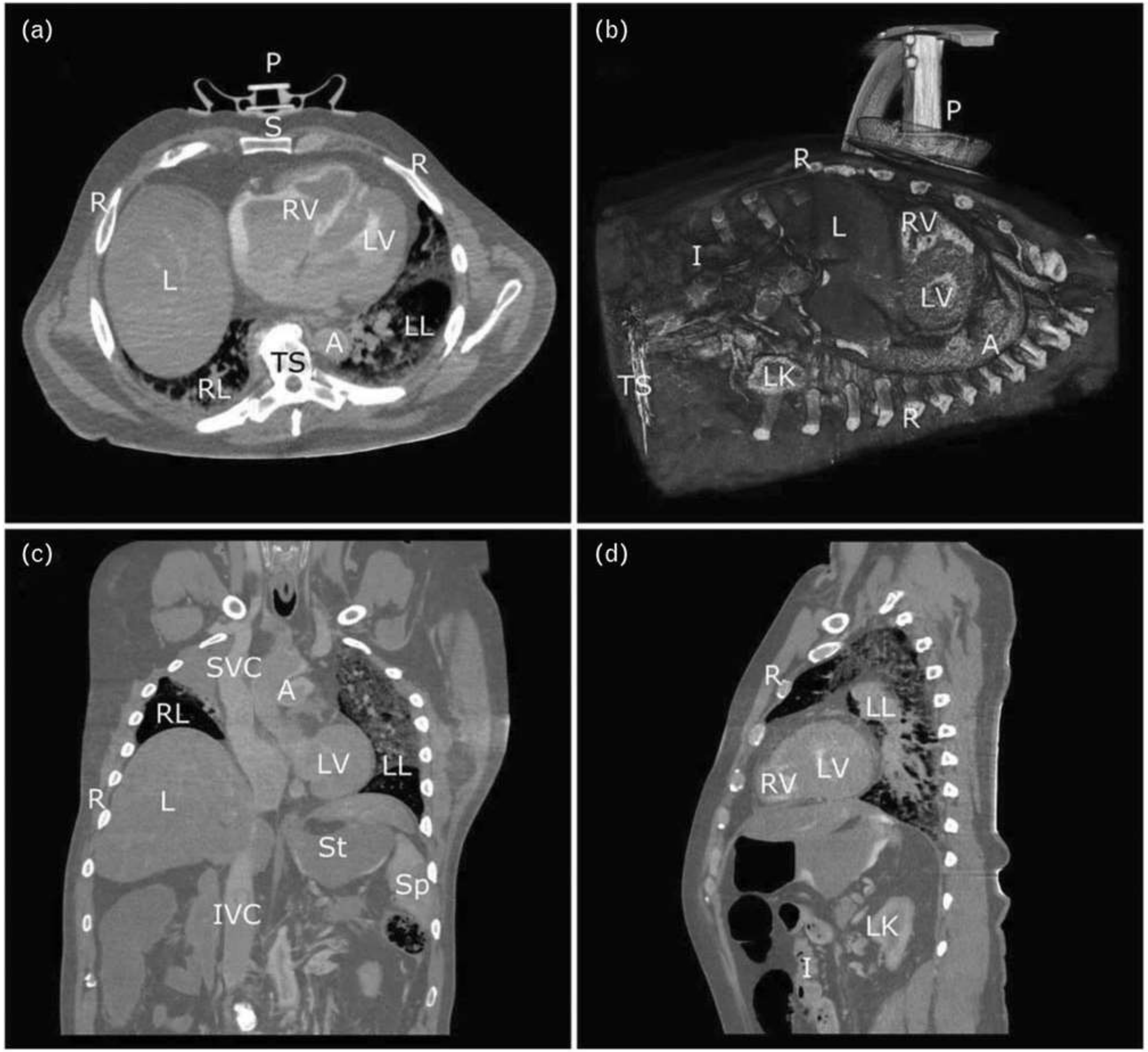


Study Design

Study Type : Interventional (Clinical Trial)
Estimated Enrollment : 150 participants
Allocation: Randomized
Intervention Model: Parallel Assignment
Masking: None (Open Label)
Primary Purpose: Treatment
Official Title: Goal-Directed **Cardiopulmonary Resuscitation** in Cardiac Arrest Using a Novel Physiological Target
Actual Study Start Date : February 11, 2022
Estimated Primary Completion Date : July 31, 2025
Estimated Study Completion Date : July 31, 2025

Arms and Interventions

Arm	Intervention/treatment
Experimental: Physiological Feedback CPR	Other: Physiological Feedback CPR Physiological feedback CPR using an optimal regional O2 Saturation (rSO2), **End-tidal CO2** (ETCO2) or combined (rSO2/ETCO2) target
Active Comparator: Non-Physiological (Audiovisual) Feedback CPR	Other: Non-Physiological Feedback CPR Non-physiologically guided CPR using AV feedback (integrated into defibrillators)


(a)
P
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(b)
P
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R
(c)
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IVC
(d)
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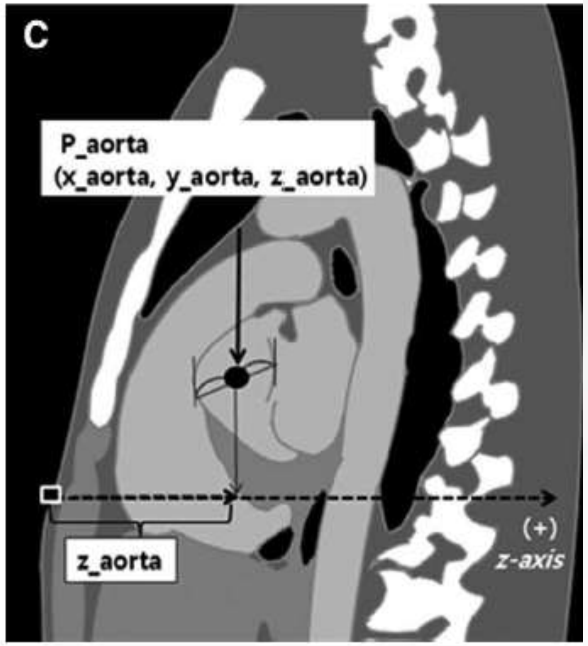
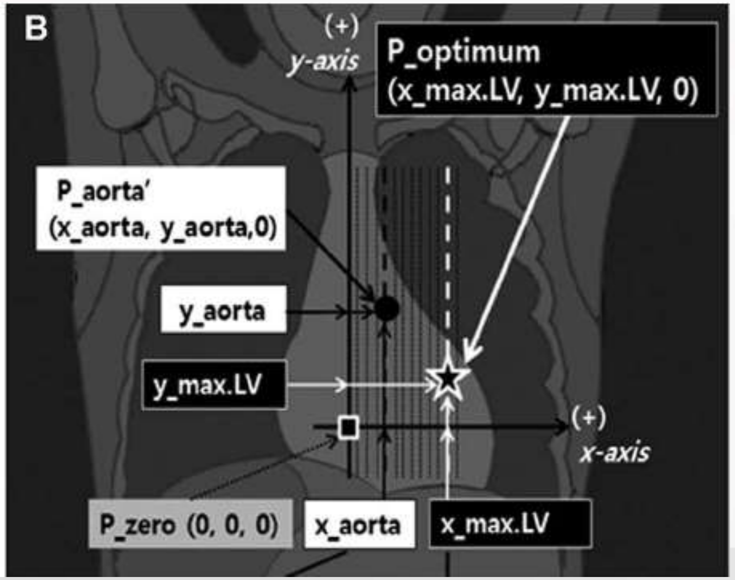
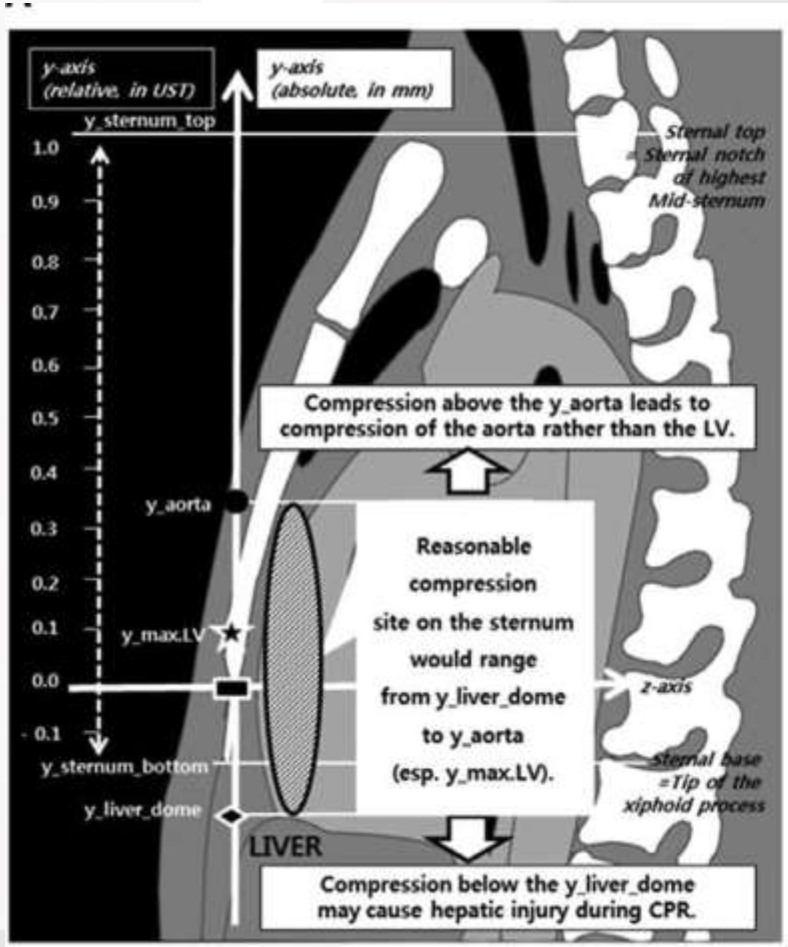
LV
RV
LK
I



Optimum Chest Compression Point for Cardiopulmonary Resuscitation in Children Revisited Using a 3D Coordinate System Imposed on CT: A Retrospective, Cross-Sectional Study

Myoungjae Park, MD[1]; Won Sup Oh, MD, PhD[2]; Sung-Bin Chon, MD, MSc[1]; Sunho Cho, MD[1]

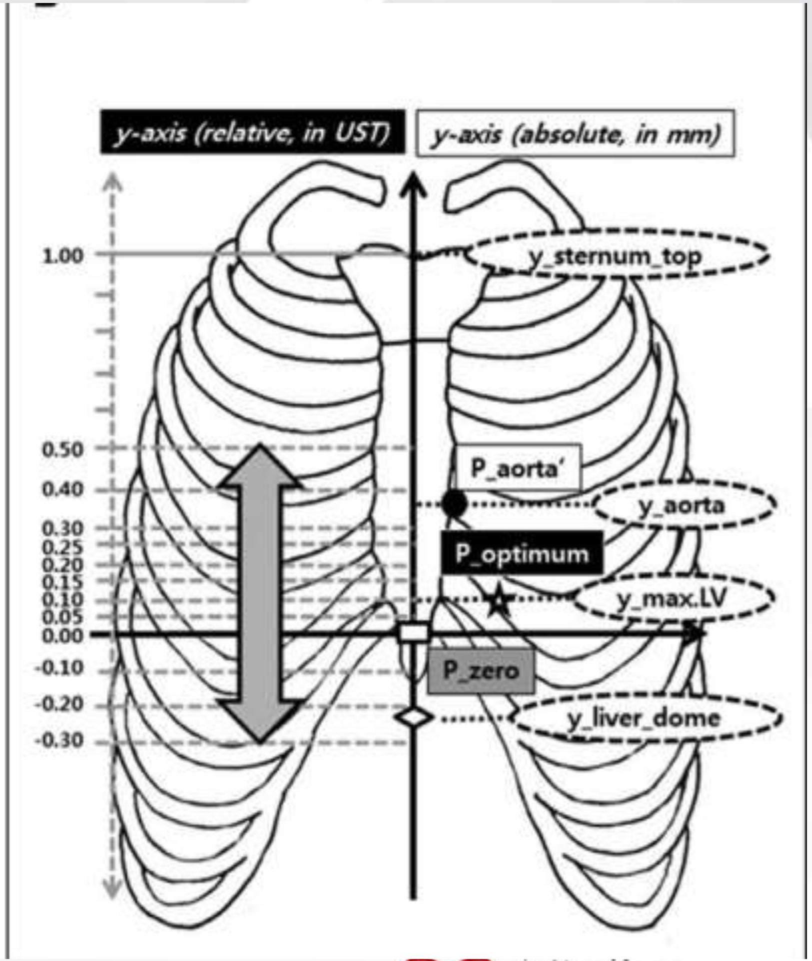




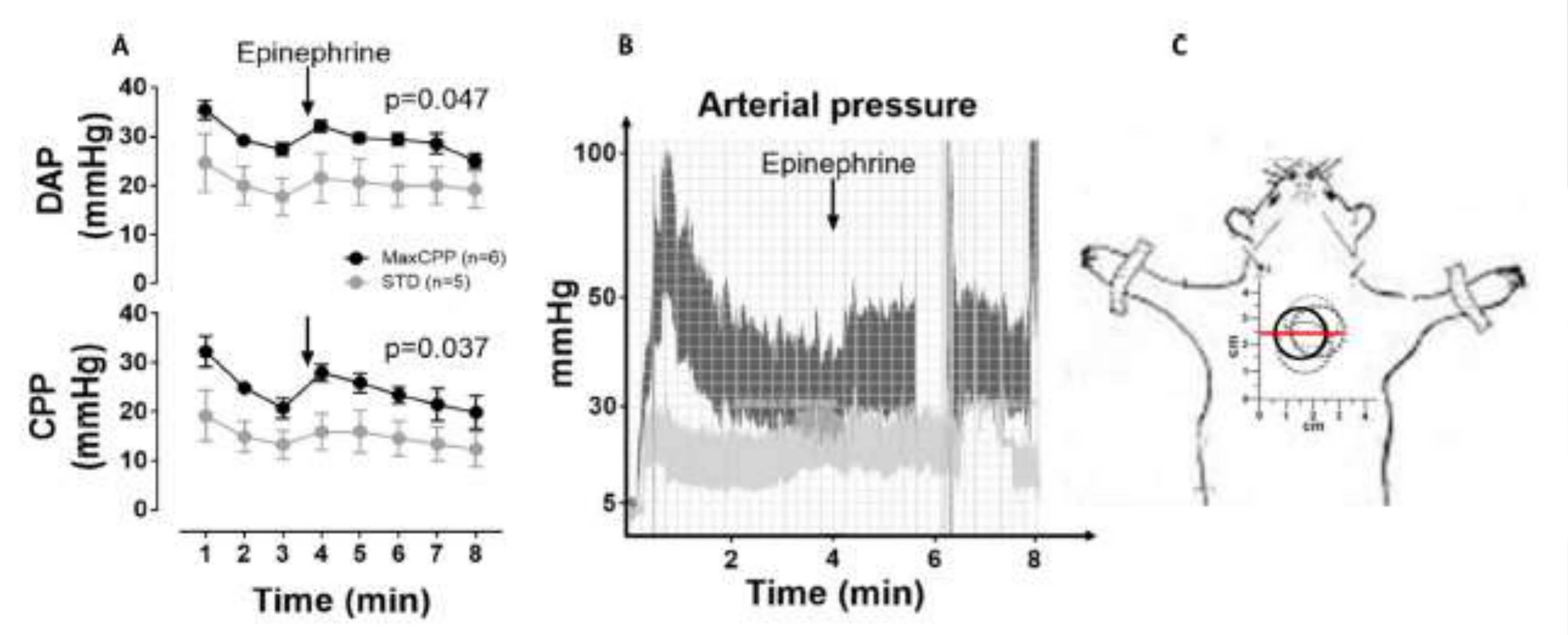
Compression above the y_aorta leads to compression of the aorta rather than the LV.

Reasonable compression site on the sternum would range from y_liver_dome to y_aorta (esp. y_max.LV).

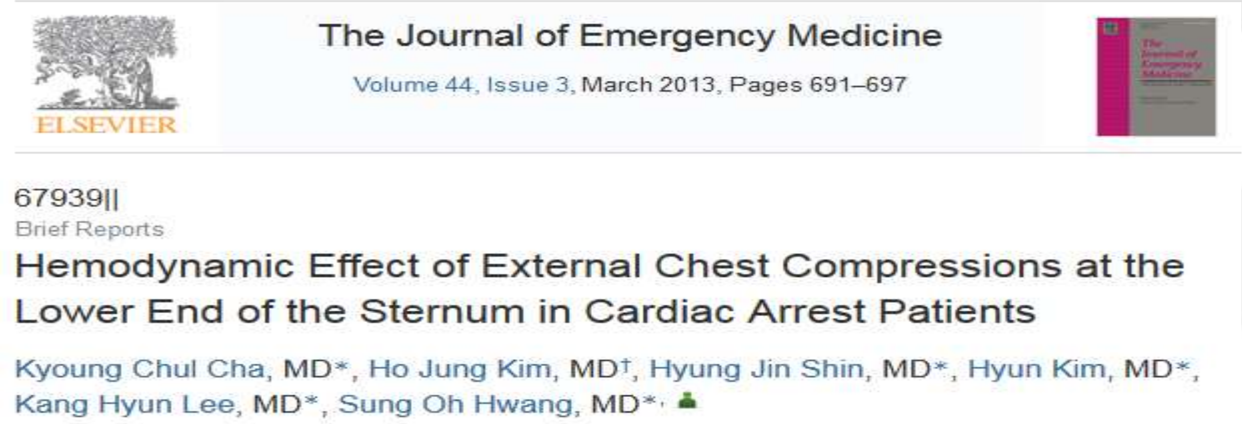
Compression below the y_liver_dome may cause hepatic injury during CPR.



Identifying the optimum chest compression point during cardiopulmonary resuscitation



Heart & Lung 49 (2020) 207 – 208

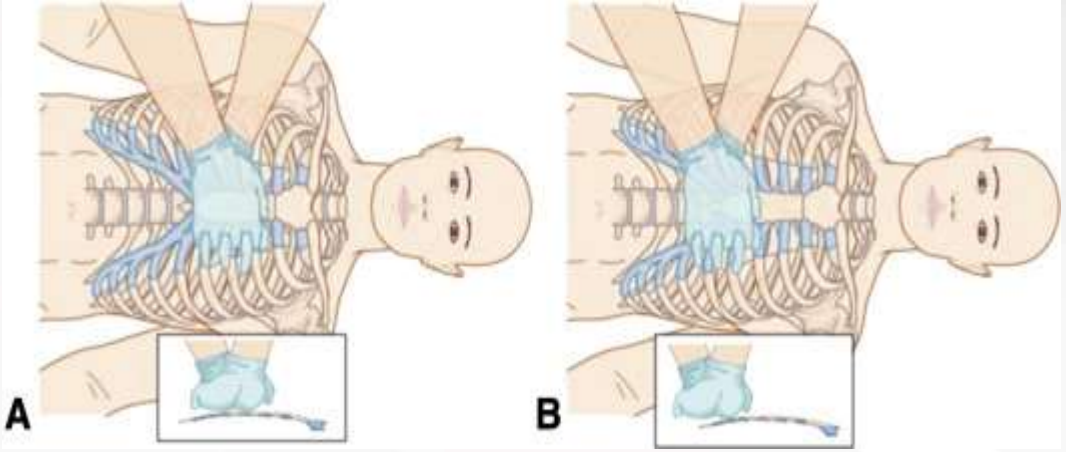


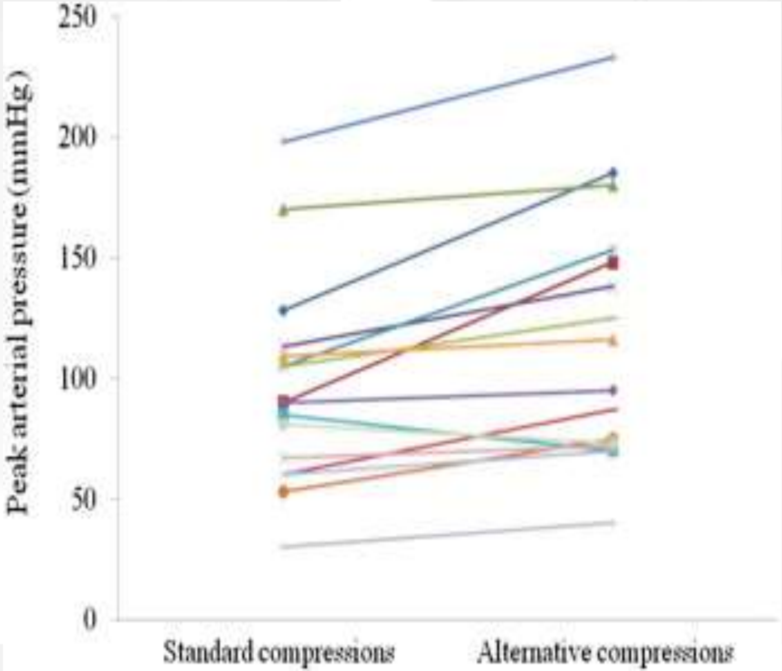
The Journal of Emergency Medicine
Volume 44, Issue 3, March 2013, Pages 691–697

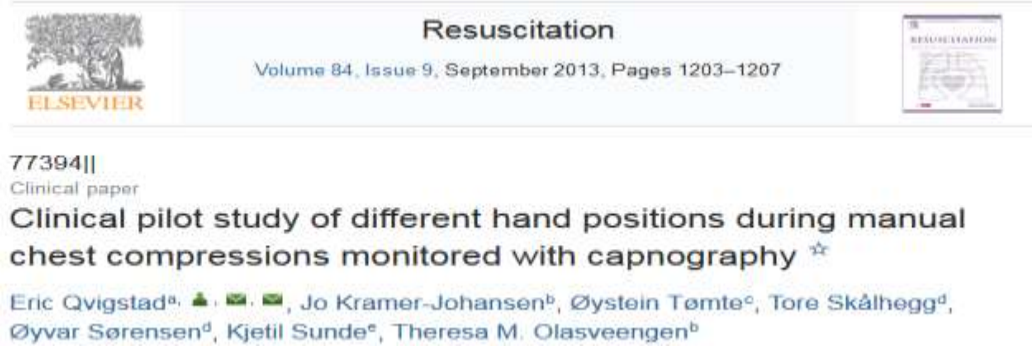
67939||
Brief Reports

Hemodynamic Effect of External Chest Compressions at the Lower End of the Sternum in Cardiac Arrest Patients

Kyoung Chul Cha, MD*, Ho Jung Kim, MD†, Hyung Jin Shin, MD*, Hyun Kim, MD*, Kang Hyun Lee, MD*, Sung Oh Hwang, MD*





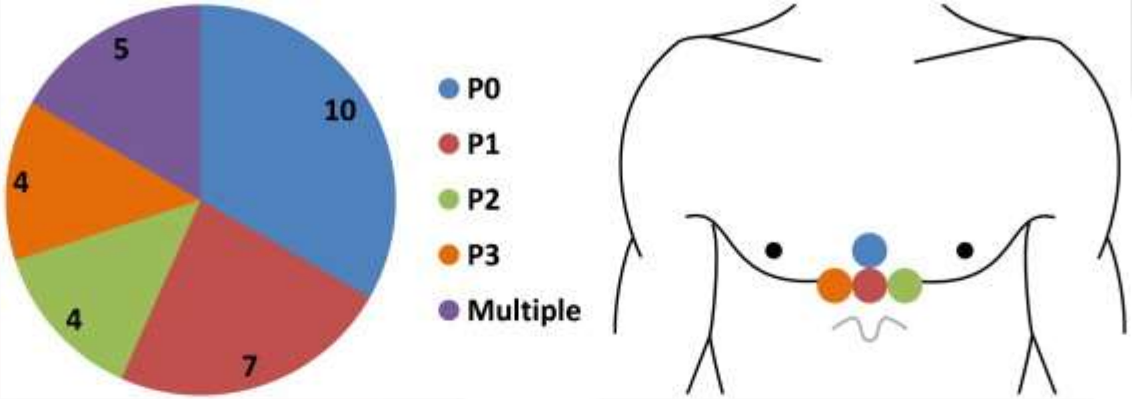


Resuscitation
Volume 84, Issue 9, September 2013, Pages 1203–1207

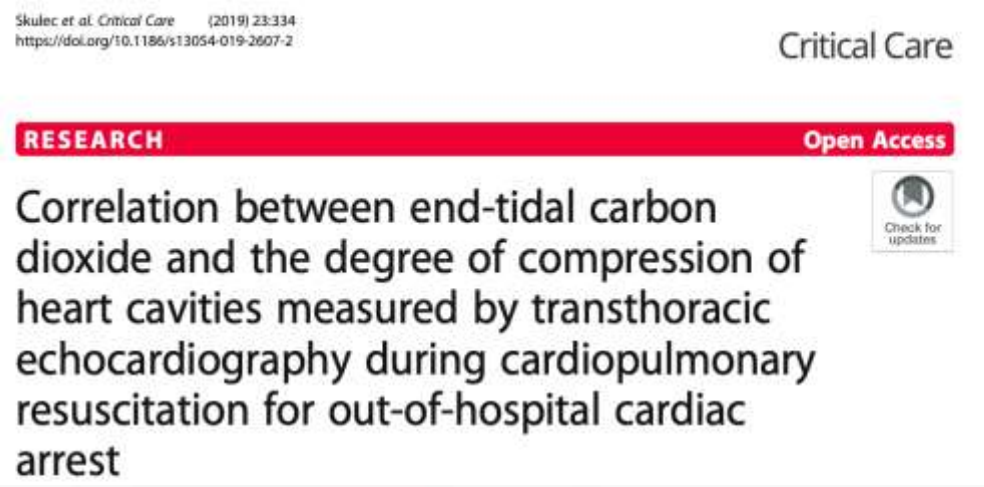
77394||
Clinical paper

Clinical pilot study of different hand positions during manual chest compressions monitored with capnography ☆

Eric Qvigstad[a], Jo Kramer-Johansen[b], Øystein Tømte[c], Tore Skålhegg[d], Øyvar Sørensen[d], Kjetil Sunde[e], Theresa M. Olasveengen[b]



- *Inter-individual differences suggest optimal hand position might vary significantly among patients*
- *ALS team could find the better hand position for hemodynamics based on effects on EtCO2*

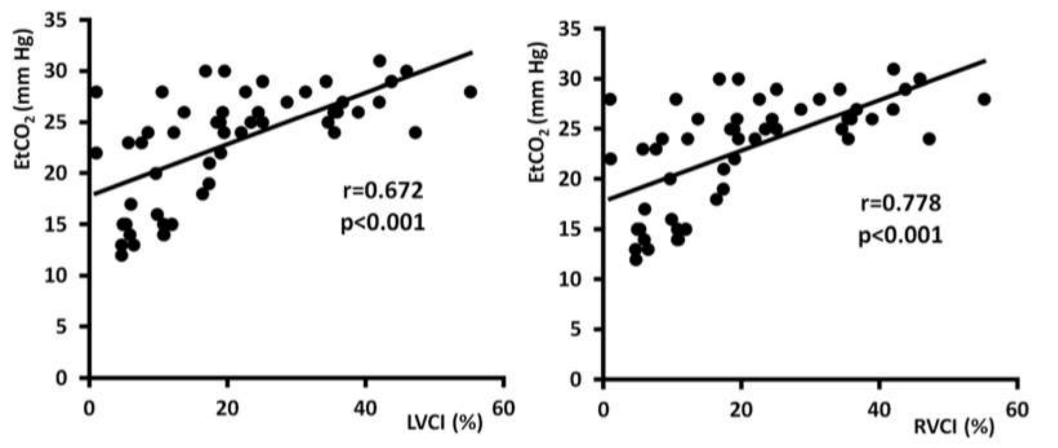


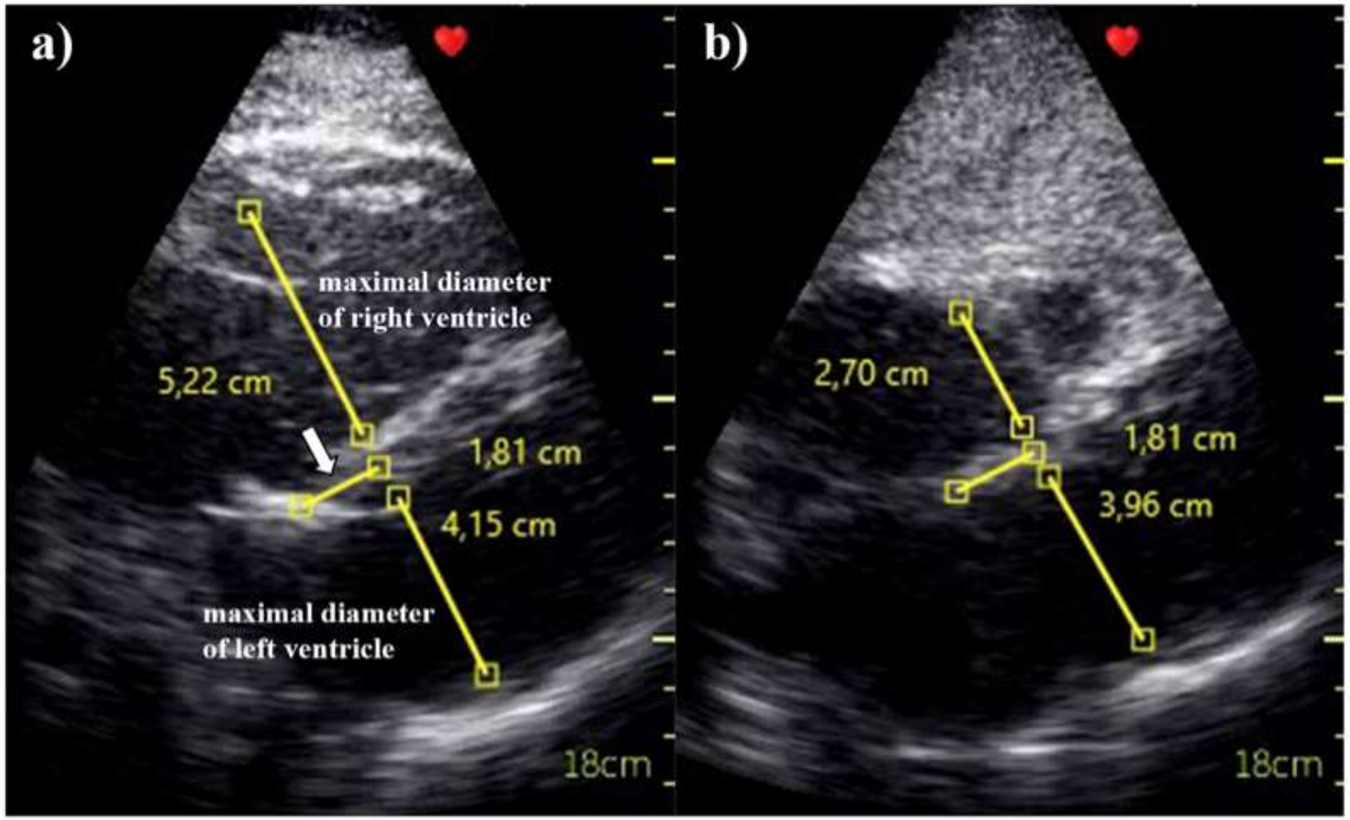
Skulec *et al. Critical Care* (2019) 23:334
https://doi.org/10.1186/s13054-019-2607-2

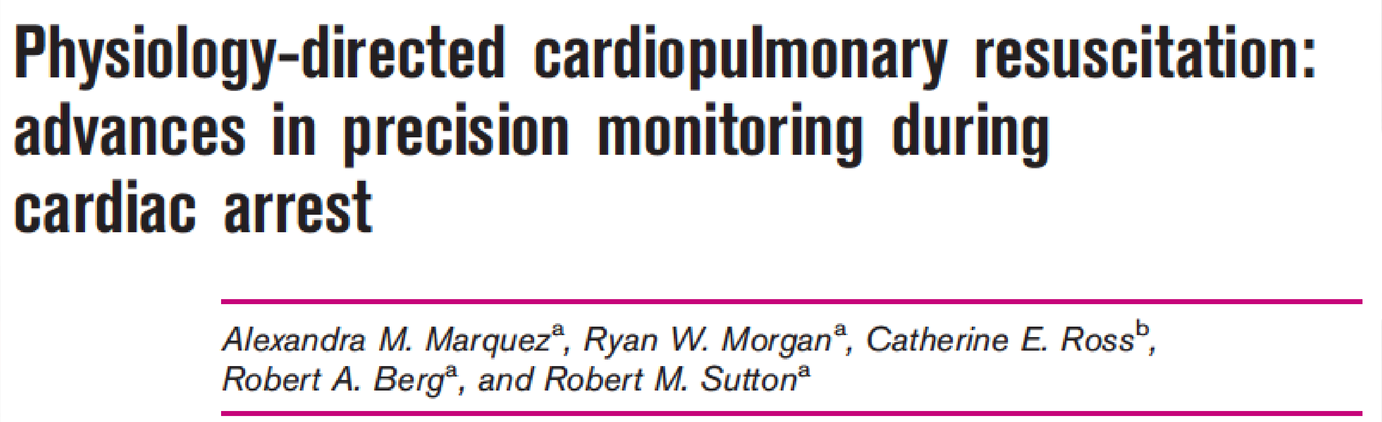
Critical Care

RESEARCH **Open Access**

Correlation between end-tidal carbon dioxide and the degree of compression of heart cavities measured by transthoracic echocardiography during cardiopulmonary resuscitation for out-of-hospital cardiac arrest







Physiology-directed cardiopulmonary resuscitation: advances in precision monitoring during cardiac arrest

Alexandra M. Marquez[a], Ryan W. Morgan[a], Catherine E. Ross[b], Robert A. Berg[a], and Robert M. Sutton[a]

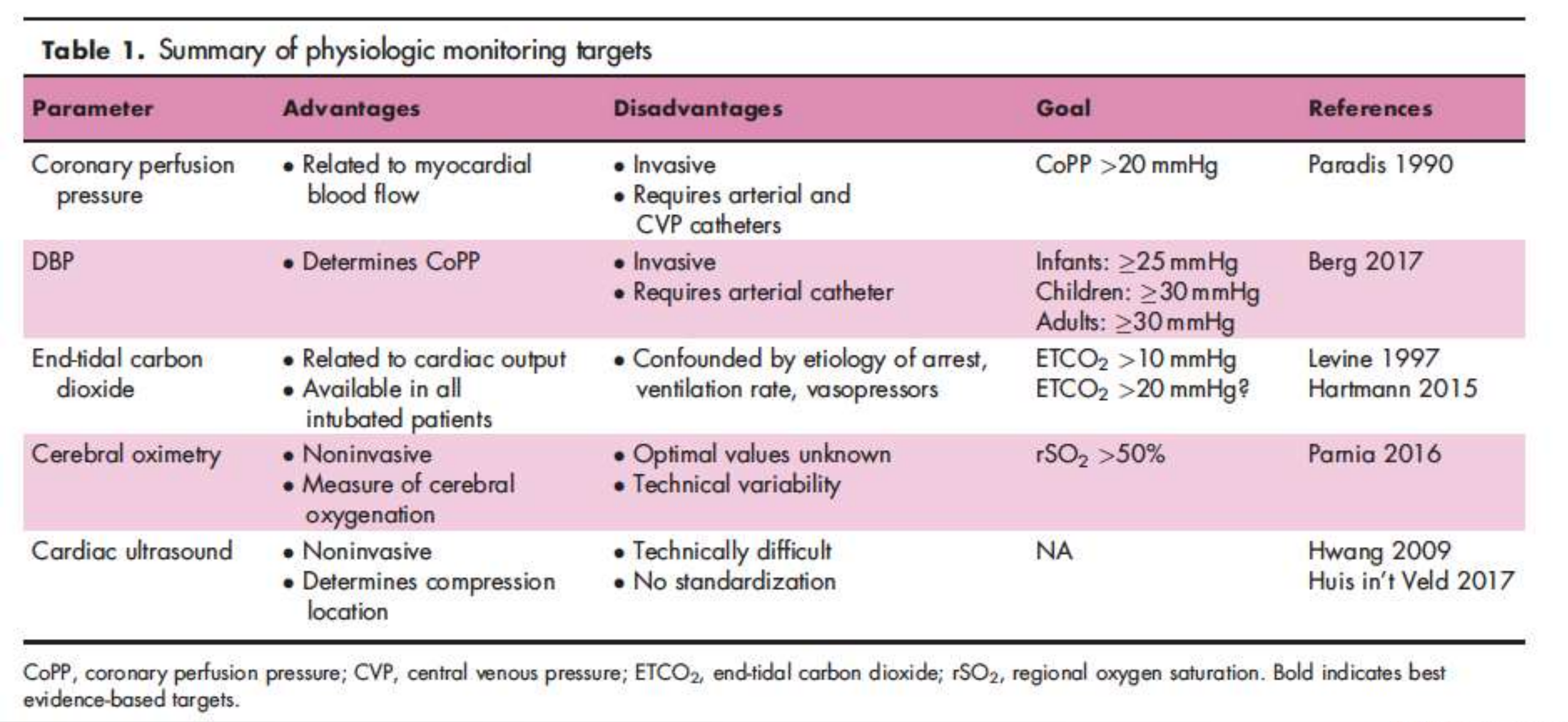


Table 1. Summary of physiologic monitoring targets

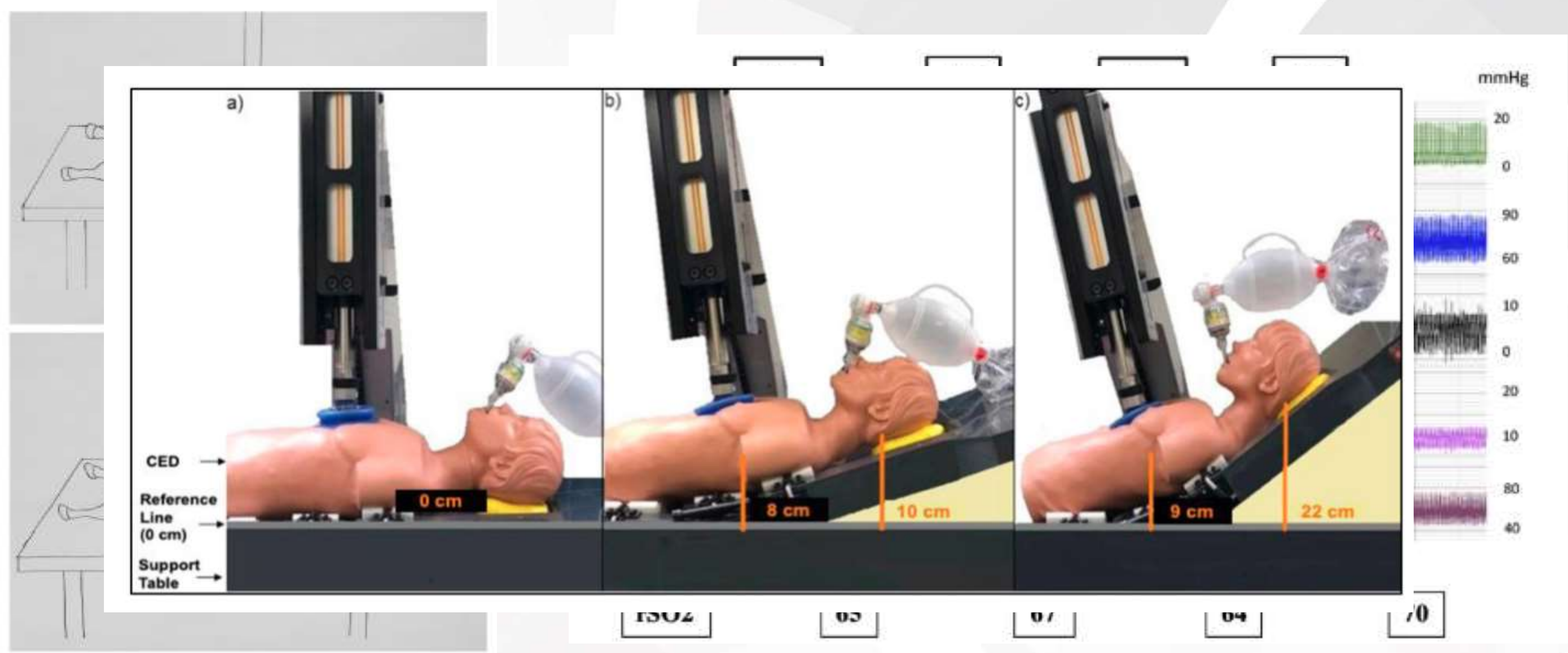
Parameter	Advantages	Disadvantages	Goal	References
Coronary perfusion pressure	• Related to myocardial blood flow	• Invasive • Requires arterial and CVP catheters	CoPP >20 mmHg	Paradis 1990
DBP	• Determines CoPP	• Invasive • Requires arterial catheter	Infants: ≥25 mmHg Children: ≥30 mmHg Adults: ≥30 mmHg	Berg 2017
End-tidal carbon dioxide	• Related to cardiac output • Available in all intubated patients	• Confounded by etiology of arrest, ventilation rate, vasopressors	$ETCO_2$ >10 mmHg $ETCO_2$ >20 mmHg?	Levine 1997 Hartmann 2015
Cerebral oximetry	• Noninvasive • Measure of cerebral oxygenation	• Optimal values unknown • Technical variability	rSO_2 >50%	Parnia 2016
Cardiac ultrasound	• Noninvasive • Determines compression location	• Technically difficult • No standardization	NA	Hwang 2009 Huis in't Veld 2017

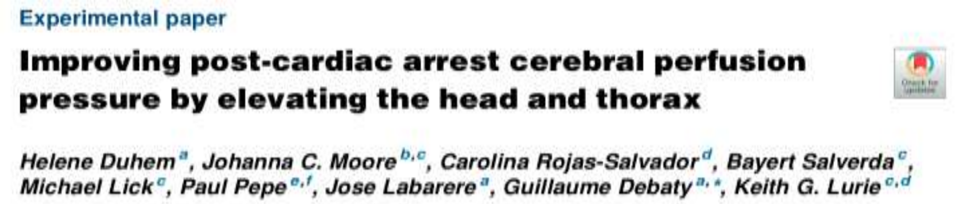
CoPP, coronary perfusion pressure; CVP, central venous pressure; $ETCO_2$, end-tidal carbon dioxide; rSO_2, regional oxygen saturation. Bold indicates best evidence-based targets.

2018

AUGMENTING PERFUSION

Head-up cardiopulmonary resuscitation

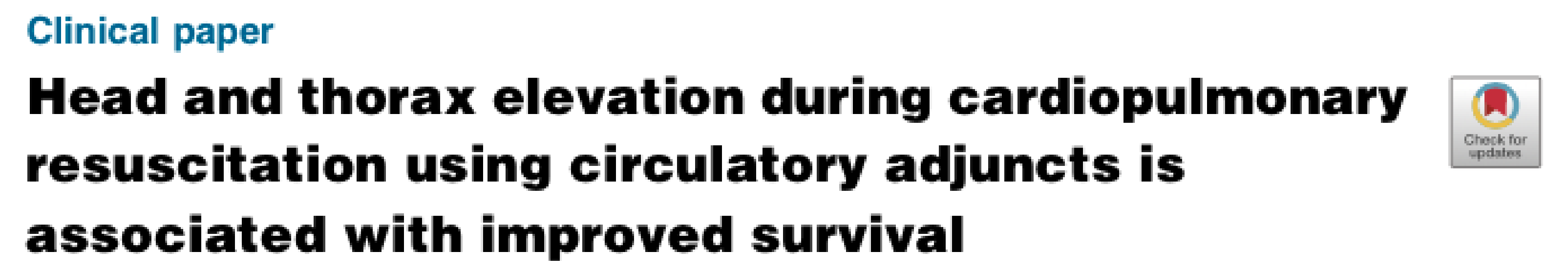



Experimental paper

Improving post-cardiac arrest cerebral perfusion pressure by elevating the head and thorax

Helene Duhem[a], Johanna C. Moore[b,c], Carolina Rojas-Salvador[d], Bayert Salverda[c], Michael Lick[c], Paul Pepe[e,f], Jose Labarere[a], Guillaume Debaty[a,], Keith G. Lurie[c,d]*

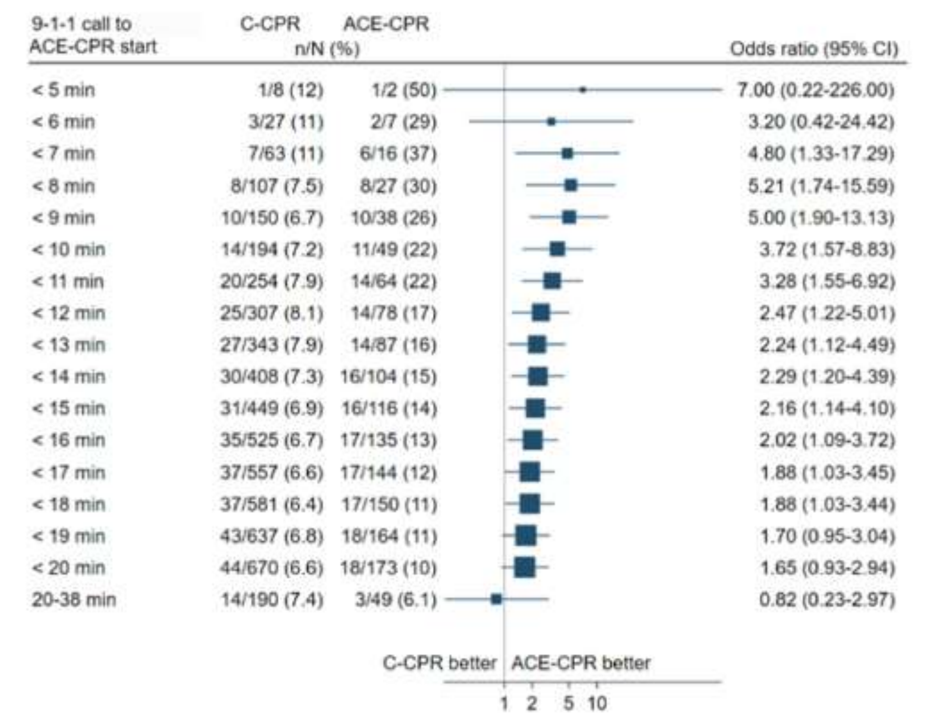
2021 Swine model



Clinical paper

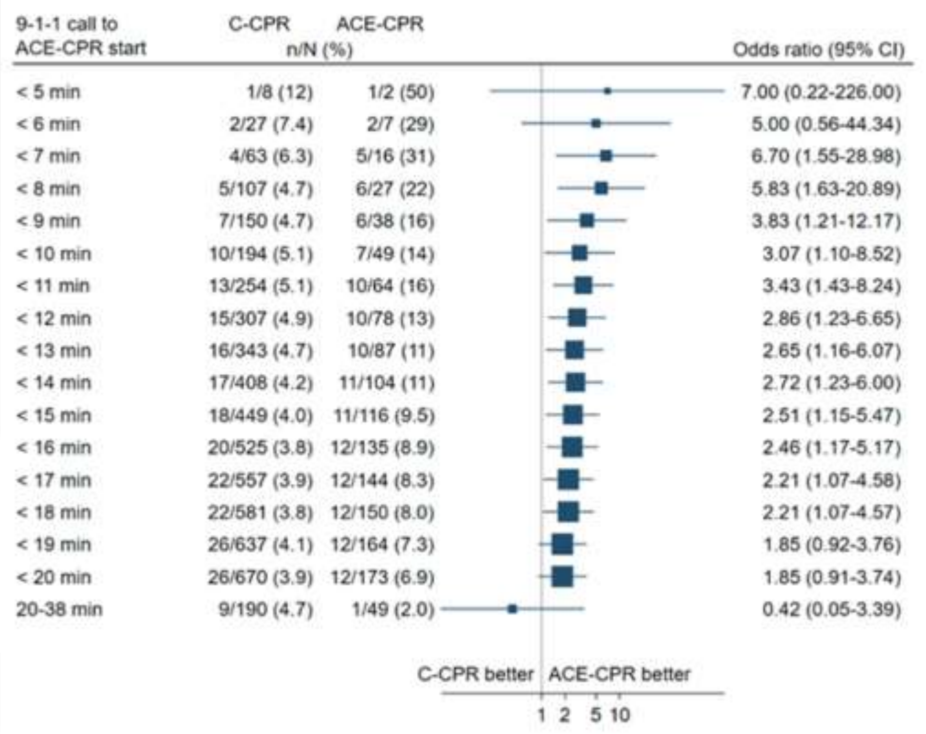
Head and thorax elevation during cardiopulmonary resuscitation using circulatory adjuncts is associated with improved survival

227 ACE-CPR OHCA patients were enrolled 04/2019–07/2020 from 6 pre-hospital systems



9-1-1 call to ACE-CPR start	C-CPR n/N (%)	ACE-CPR n/N (%)	Odds ratio (95% CI)
< 5 min	1/8 (12)	1/2 (50)	7.00 (0.22-226.00)
< 6 min	3/27 (11)	2/7 (29)	3.20 (0.42-24.42)
< 7 min	7/63 (11)	6/16 (37)	4.80 (1.33-17.29)
< 8 min	8/107 (7.5)	8/27 (30)	5.21 (1.74-15.59)
< 9 min	10/150 (6.7)	10/38 (26)	5.00 (1.90-13.13)
< 10 min	14/194 (7.2)	11/49 (22)	3.72 (1.57-8.83)
< 11 min	20/254 (7.9)	14/64 (22)	3.28 (1.55-6.92)
< 12 min	25/307 (8.1)	14/78 (17)	2.47 (1.22-5.01)
< 13 min	27/343 (7.9)	14/87 (16)	2.24 (1.12-4.49)
< 14 min	30/408 (7.3)	16/104 (15)	2.29 (1.20-4.39)
< 15 min	31/449 (6.9)	16/116 (14)	2.16 (1.14-4.10)
< 16 min	35/525 (6.7)	17/135 (13)	2.02 (1.09-3.72)
< 17 min	37/557 (6.6)	17/144 (12)	1.88 (1.03-3.45)
< 18 min	37/581 (6.4)	17/150 (11)	1.88 (1.03-3.44)
< 19 min	43/637 (6.8)	18/164 (11)	1.70 (0.95-3.04)
< 20 min	44/670 (6.6)	18/173 (10)	1.65 (0.93-2.94)
20-38 min	14/190 (7.4)	3/49 (6.1)	0.82 (0.23-2.97)

Hospital discharge



9-1-1 call to ACE-CPR start	C-CPR n/N (%)	ACE-CPR n/N (%)	Odds ratio (95% CI)
< 5 min	1/8 (12)	1/2 (50)	7.00 (0.22-226.00)
< 6 min	2/27 (7.4)	2/7 (29)	5.00 (0.56-44.34)
< 7 min	4/63 (6.3)	5/16 (31)	6.70 (1.55-28.98)
< 8 min	5/107 (4.7)	6/27 (22)	5.83 (1.63-20.89)
< 9 min	7/150 (4.7)	6/38 (16)	3.83 (1.21-12.17)
< 10 min	10/194 (5.1)	7/49 (14)	3.07 (1.10-8.52)
< 11 min	13/254 (5.1)	10/64 (16)	3.43 (1.43-8.24)
< 12 min	15/307 (4.9)	10/78 (13)	2.86 (1.23-6.65)
< 13 min	16/343 (4.7)	10/87 (11)	2.65 (1.16-6.07)
< 14 min	17/408 (4.2)	11/104 (11)	2.72 (1.23-6.00)
< 15 min	18/449 (4.0)	11/116 (9.5)	2.51 (1.15-5.47)
< 16 min	20/525 (3.8)	12/135 (8.9)	2.46 (1.17-5.17)
< 17 min	22/557 (3.9)	12/144 (8.3)	2.21 (1.07-4.58)
< 18 min	22/581 (3.8)	12/150 (8.0)	2.21 (1.07-4.57)
< 19 min	26/637 (4.1)	12/164 (7.3)	1.85 (0.92-3.76)
< 20 min	26/670 (3.9)	12/173 (6.9)	1.85 (0.91-3.74)
20-38 min	9/190 (4.7)	1/49 (2.0)	0.42 (0.05-3.39)

Favorable neurological outcome

2022

Schiller

Defibtech

Corpuls

Stryke

ZOLL

Animax

China CPR

Michigan Thumper

ROSC-U

Reax Vest CPR

MCC-E

Sun Life

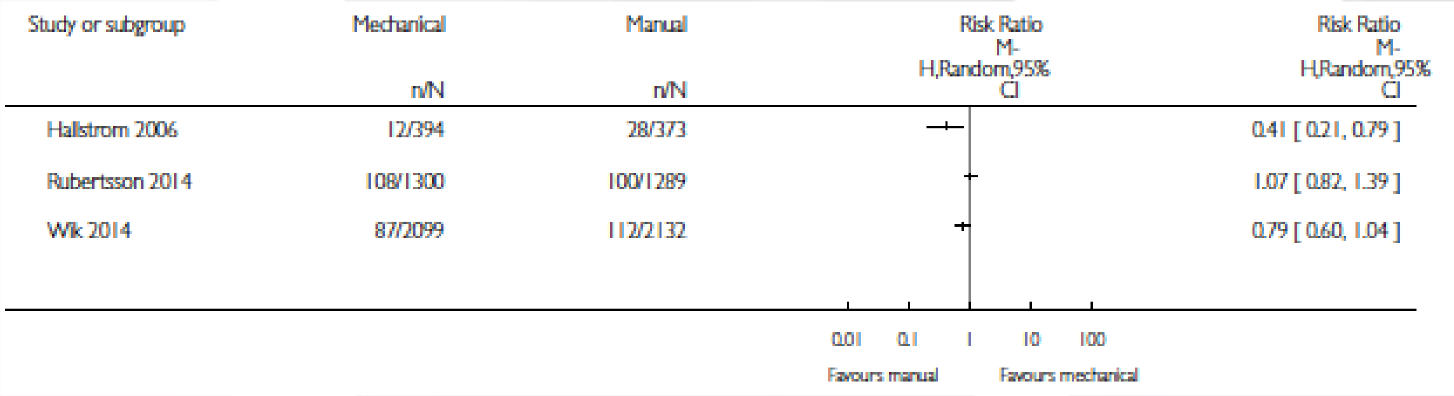
Cochrane Library

Cochrane Database of Systematic Reviews

Mechanical versus manual chest compressions for cardiac arrest (Review)

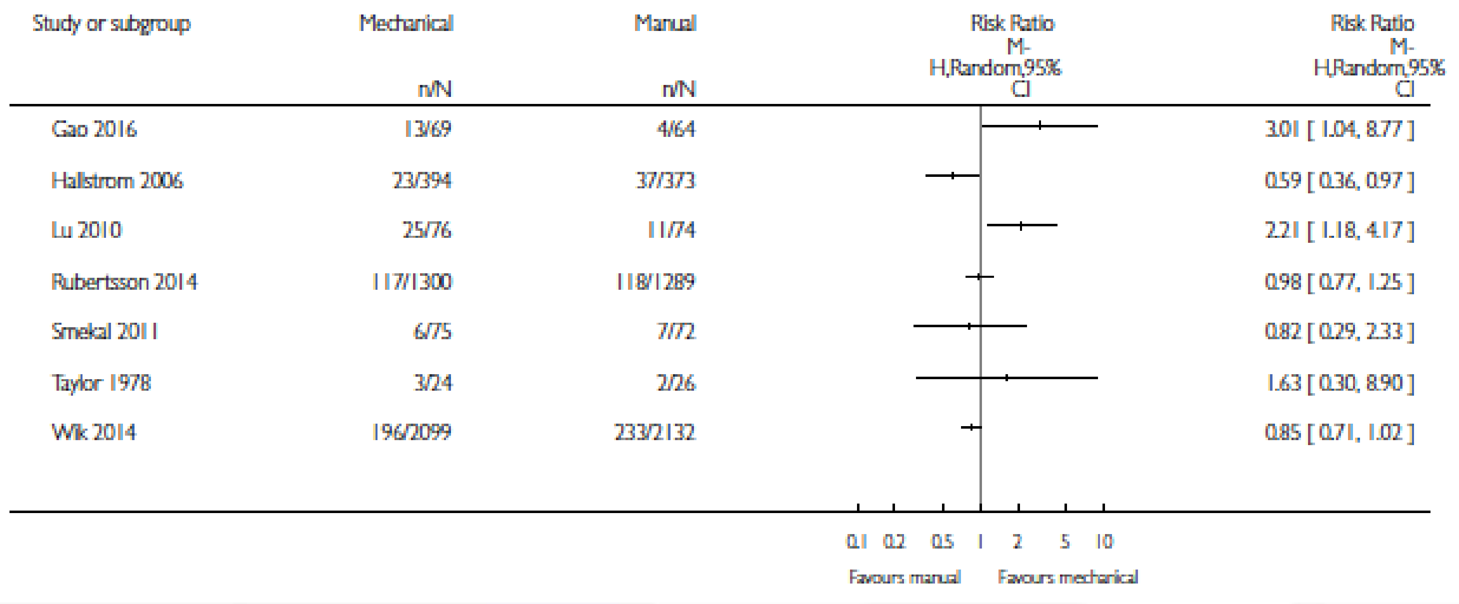
Wang PL, Brooks SC

Survival to with good neurological function



Study or subgroup	Mechanical n/N	Manual n/N	Risk Ratio M-H,Random,95% CI	Risk Ratio M-H,Random,95% CI
Hallstrom 2006	12/394	28/373		0.41 [0.21, 0.79]
Rubertsson 2014	108/1300	100/1289		1.07 [0.82, 1.39]
Wik 2014	87/2099	112/2132		0.79 [0.60, 1.04]

Survival to hospital discharge



Study or subgroup	Mechanical n/N	Manual n/N	Risk Ratio M-H,Random,95% CI	Risk Ratio M-H,Random,95% CI
Gao 2016	13/69	4/64		3.01 [1.04, 8.77]
Hallstrom 2006	23/394	37/373		0.59 [0.36, 0.97]
Lu 2010	25/76	11/74		2.21 [1.18, 4.17]
Rubertsson 2014	117/1300	118/1289		0.98 [0.77, 1.25]
Smekal 2011	6/75	7/72		0.82 [0.29, 2.33]
Taylor 1978	3/24	2/26		1.63 [0.30, 8.90]
Wik 2014	196/2099	233/2132		0.85 [0.71, 1.02]

2018

IRC Italian Resuscitation Council

Contents lists available at SciVerse ScienceDirect

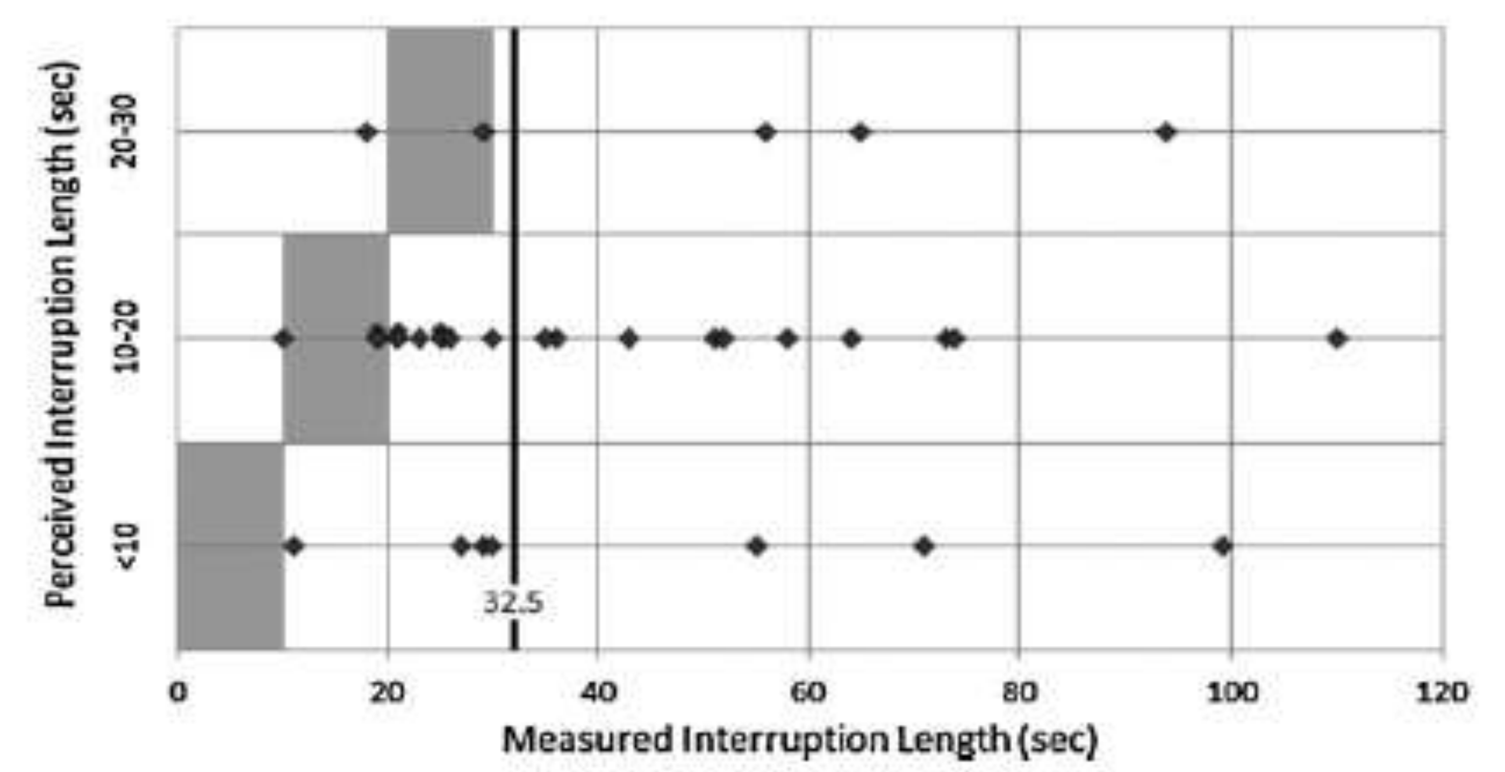
Resuscitation

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

Clinical paper

Assessment of CPR interruptions from transthoracic impedance during use of the LUCAS™ mechanical chest compression system☆

Dana Yost[a,*], Reid H. Phillips[b], Louis Gonzales[c], Charles J. Lick[d], Paul Satterlee[d], Michael Levy[e], Joseph Barger[f], Pamela Dodson[f], Stephen Poggi[g], Karen Wojcik[h], Robert A. Niskanen[i], Fred W. Chapman[h]



Interruptions in chest compressions to apply LUCAS can be <20 s but are often much longer, and users do not perceive pause time accurately
→ TRAINING!

Training approaches for the deployment of a mechanical chest compression device: a randomised controlled manikin study

Keith Couper,[1,2] Rochelle M Velho,[1,2] Tom Quinn,[3] Anne Devrell,[4] Ranjit Lall,[1]
Barry Orriss,[4] Joyce Yeung,[1,2] Gavin D Perkins[1,2]

BMJ Open 2018;**8**:e019009.

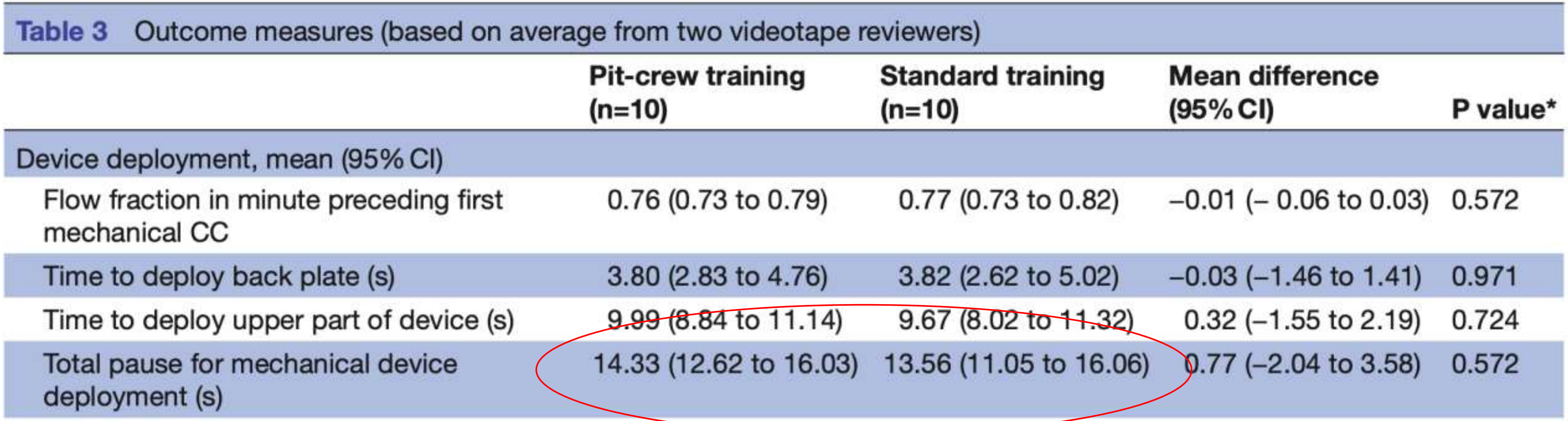


Table 3 Outcome measures (based on average from two videotape reviewers)

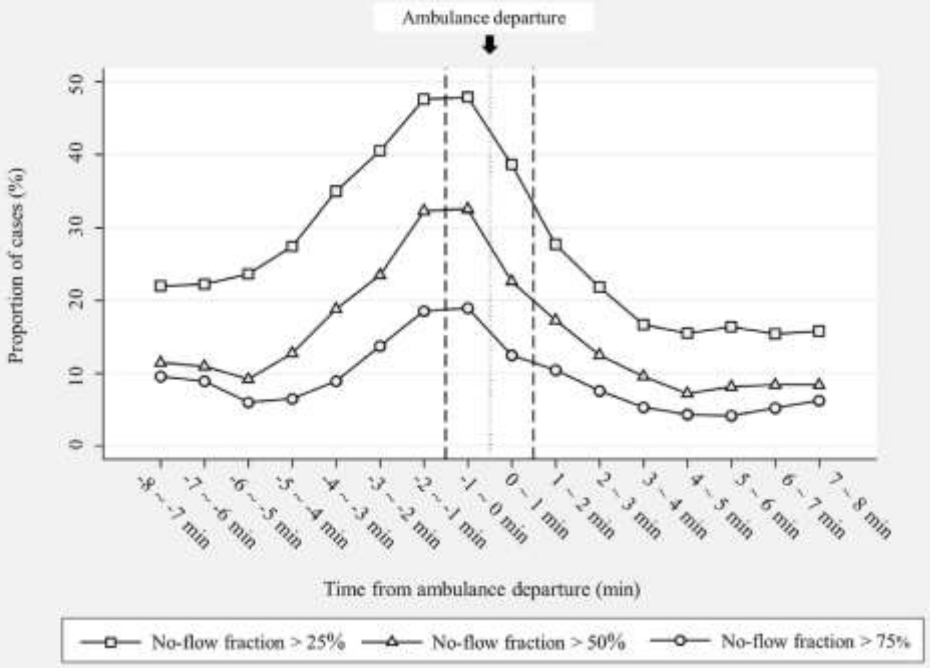
	Pit-crew training (n=10)	Standard training (n=10)	Mean difference (95% CI)	P value*
Device deployment, mean (95% CI)				
Flow fraction in minute preceding first mechanical CC	0.76 (0.73 to 0.79)	0.77 (0.73 to 0.82)	–0.01 (– 0.06 to 0.03)	0.572
Time to deploy back plate (s)	3.80 (2.83 to 4.76)	3.82 (2.62 to 5.02)	–0.03 (–1.46 to 1.41)	0.971
Time to deploy upper part of device (s)	9.99 (8.84 to 11.14)	9.67 (8.02 to 11.32)	0.32 (–1.55 to 2.19)	0.724
Total pause for mechanical device deployment (s)	14.33 (12.62 to 16.03)	13.56 (11.05 to 16.06)	0.77 (–2.04 to 3.58)	0.572

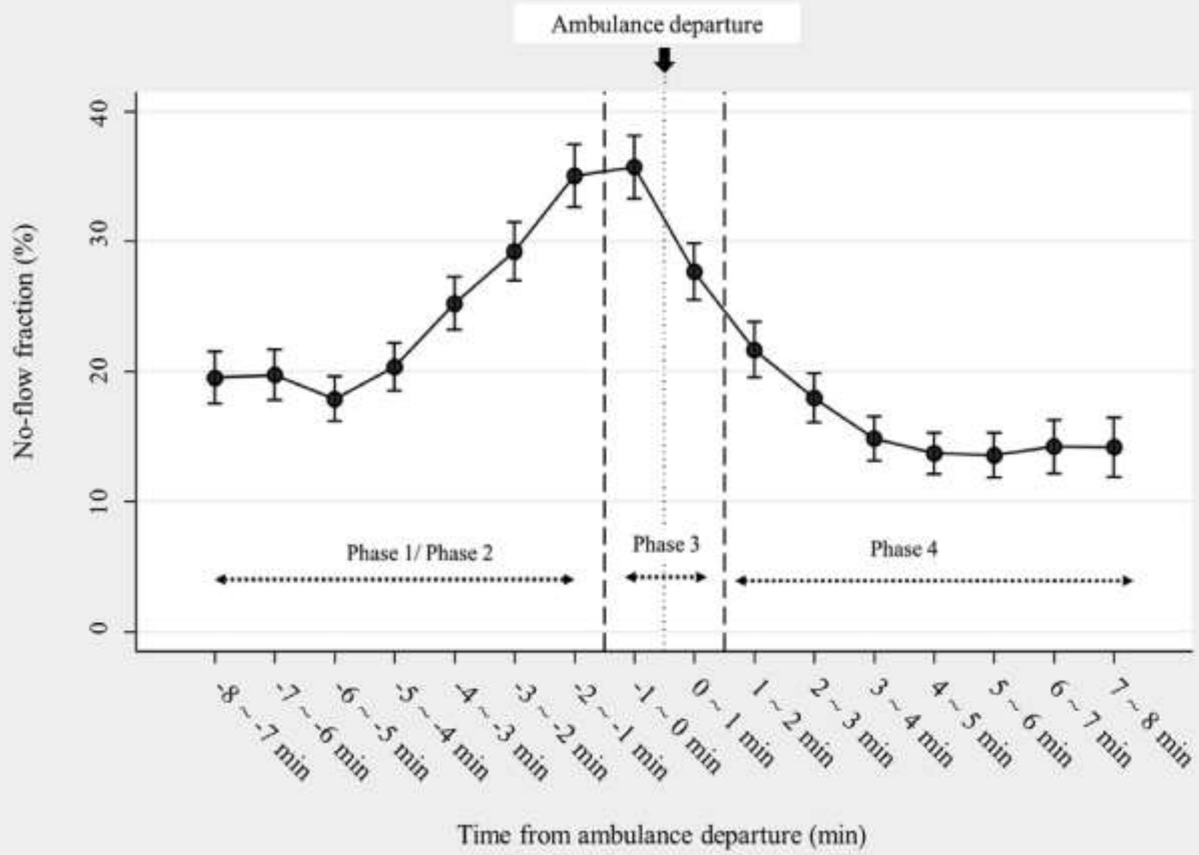
Clinical paper

Quality of chest compressions during prehospital resuscitation phase from scene arrival to ambulance transport in out-of-hospital cardiac arrest

788 OHCAs

Phase 1: first 2 min after initiation of chest compression
Phase 2: from the end of phase 1 to 1 min prior to ambulance departure
Phase 3: from 1 min before to 1 min after ambulance departure
Phase 4: from the end of phase 3 to hospital arrival





Resuscitation 2022

ADRENALINE

- Give adrenaline 1 mg IV (IO) as soon as possible for adult patients in cardiac arrest with a non-shockable rhythm
- Give adrenaline 1 mg IV (IO) after the 3rd shock for adult patients in cardiac arrest with a shockable rhythm
- Repeat adrenaline 1 mg IV (IO) every 3-5 minutes whilst ALS continues

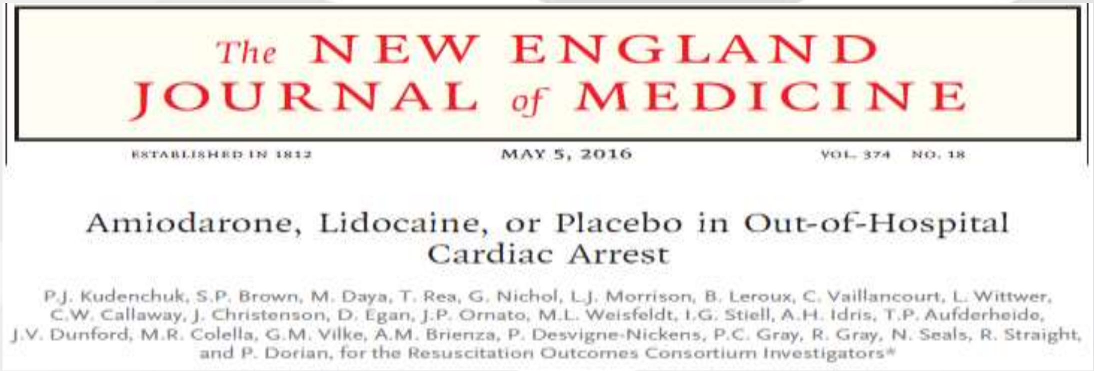
tion

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 23, 2018 VOL. 379 NO. 8

A Randomized Trial of Epinephrine in Out-of-Hospital Cardiac Arrest

G.D. Perkins, C. Ji, C.D. Deakin, T. Quinn, J.P. Nolan, C. Scomparin, S. Regan, J. Long, A. Slowther, H. Pocock,



The NEW ENGLAND JOURNAL of MEDICINE

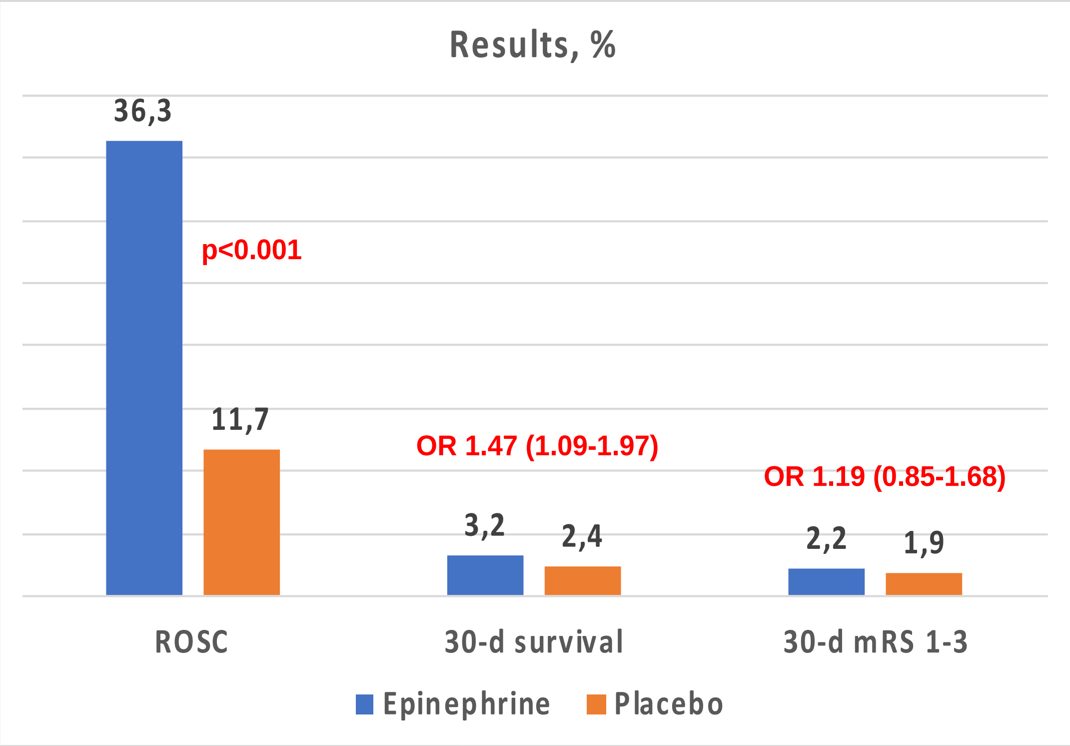
ESTABLISHED IN 1812 MAY 5, 2016 VOL. 374 NO. 18

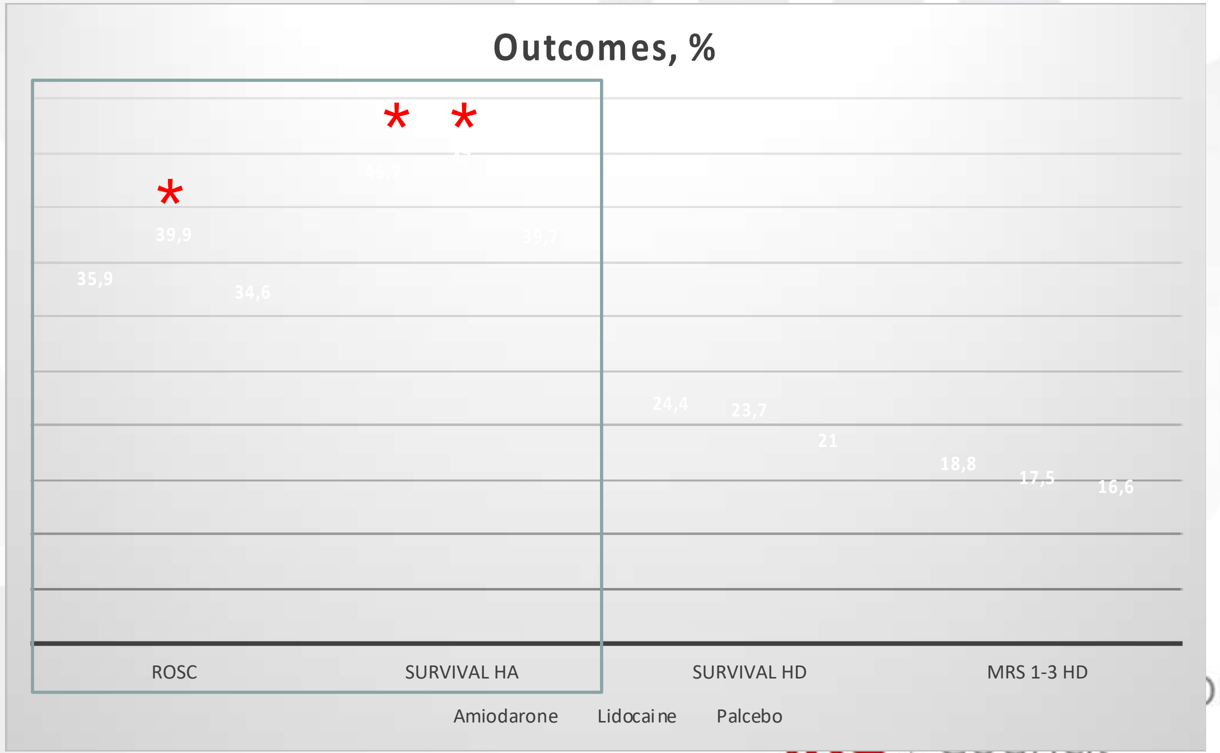
Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Cardiac Arrest

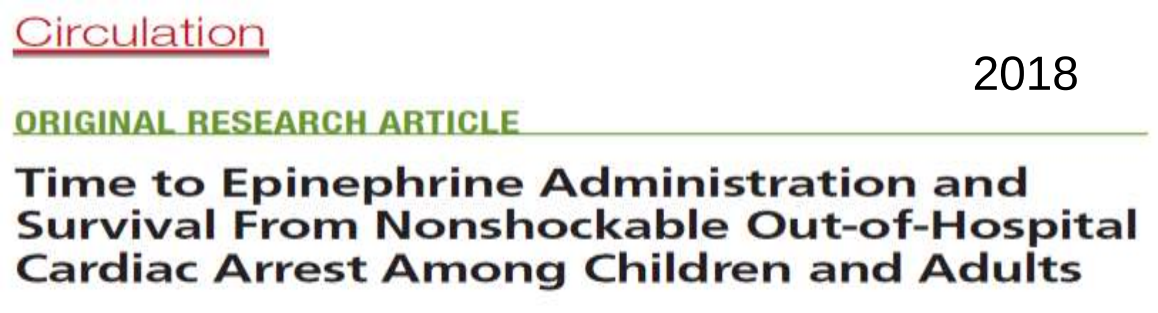
P.J. Kudenchuk, S.P. Brown, M. Daya, T. Rea, G. Nichol, L.J. Morrison, B. Leroux, C. Vaillancourt, L. Wittwer, C.W. Callaway, J. Christenson, D. Egan, J.P. Ornato, M.L. Weisfeldt, I.G. Stiell, A.H. Idris, T.P. Aufderheide, J.V. Dunford, M.R. Colella, G.M. Vilke, A.M. Brienza, P. Desvigne-Nickens, P.C. Gray, R. Gray, N. Seals, R. Straight, and P. Dorian, for the Resuscitation Outcomes Consortium Investigators*

8014 patients with out-of-hospital cardiac arrest epi (n=4015) or saline (n=3999)

3026 patients randomized, double-blind trial parenteral amiodarone (n=974), lidocaine (n=993) and saline placebo (n=1059)





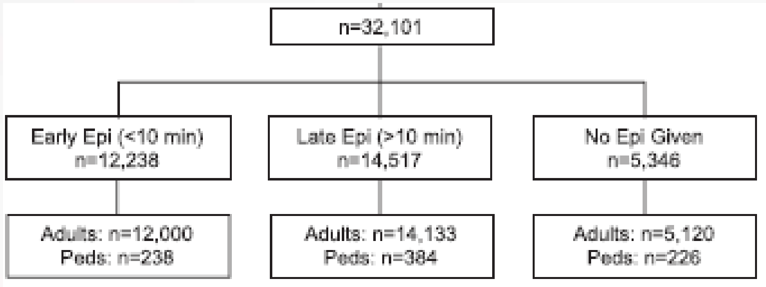


Circulation

2018

ORIGINAL RESEARCH ARTICLE

Time to Epinephrine Administration and Survival From Nonshockable Out-of-Hospital Cardiac Arrest Among Children and Adults



n=32,101

Early Epi (<10 min)
n=12,238

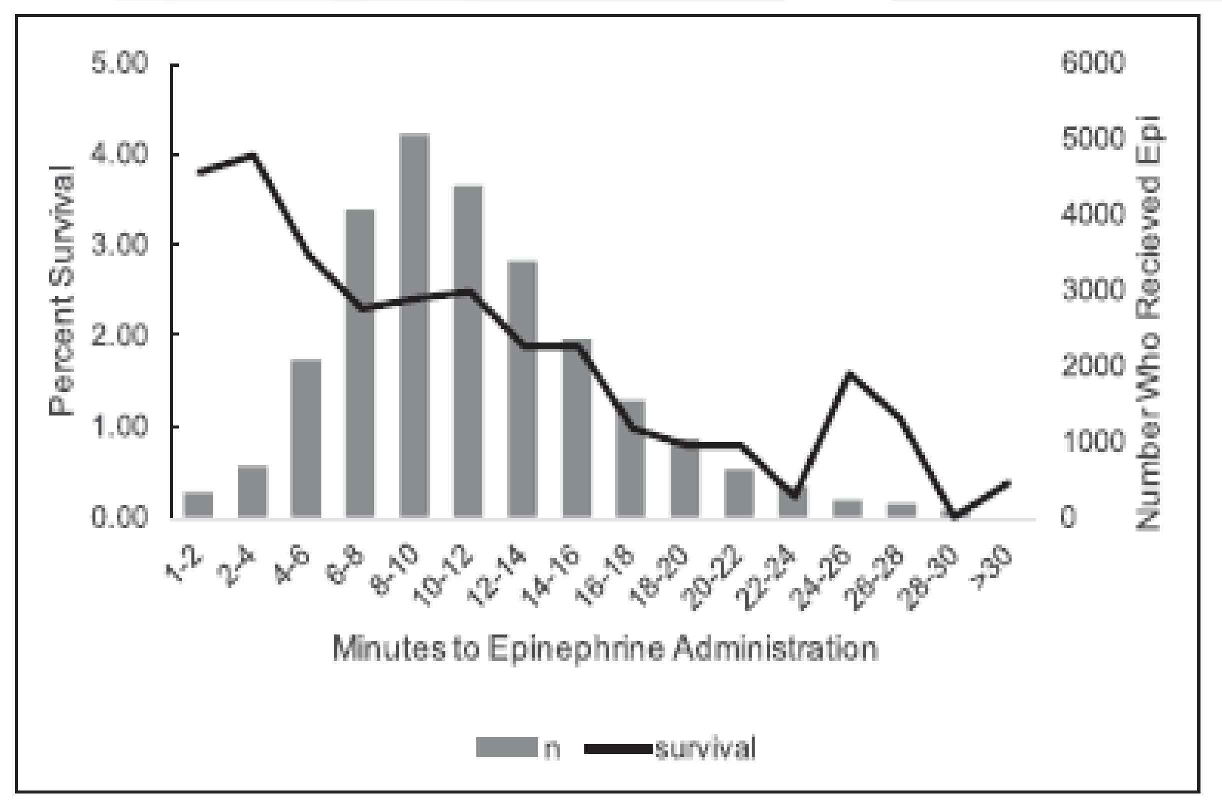
Late Epi (>10 min)
n=14,517

No Epi Given
n=5,346

Adults: n=12,000
Peds: n=238

Adults: n=14,133
Peds: n=384

Adults: n=5,120
Peds: n=226



Each minute from EMS arrival to epinephrine administration was associated with a 4% decrease in odds of survival for adults; 9% in children.

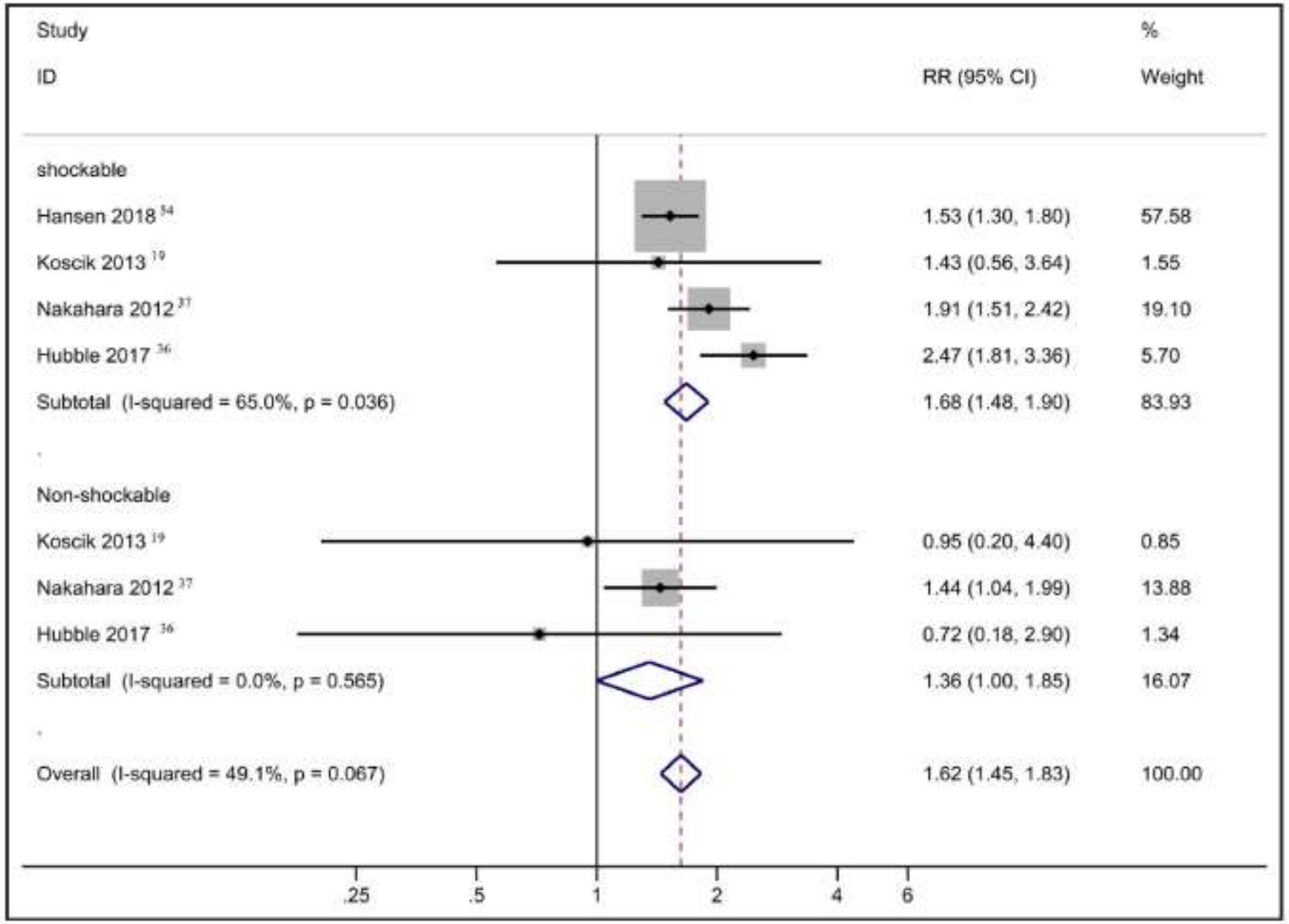
SYSTEMATIC REVIEW AND META-ANALYSIS

J Am Heart Assoc. 2020;9:e014330.

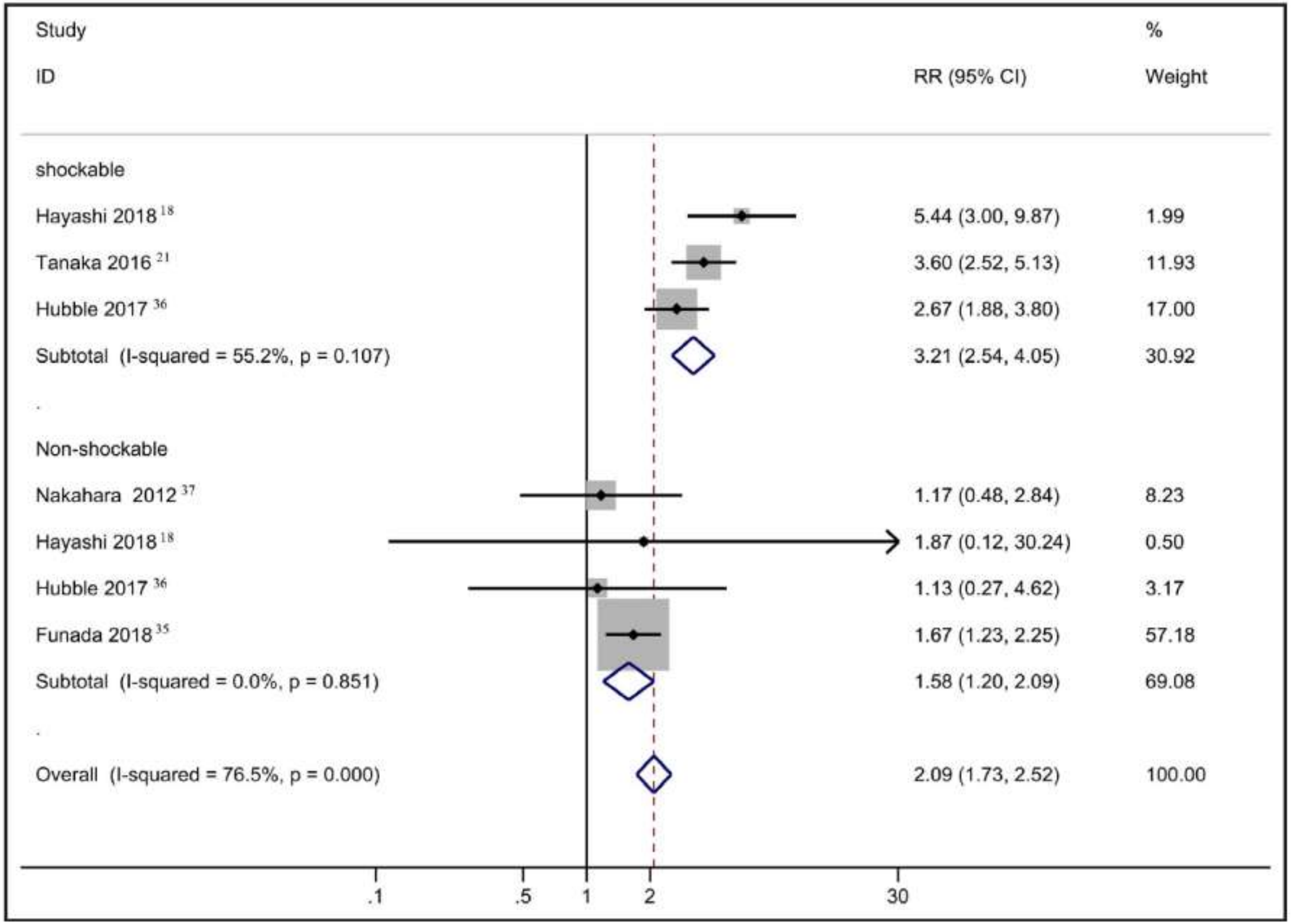
Early Administration of Adrenaline for Out-of-Hospital Cardiac Arrest: A Systematic Review and Meta-Analysis

574 392 patients
from 24 studies.

Effects of early (<10 minutes vs >10 minutes) pre-hospital adrenaline administration on survival to discharge/1 mo.



Effects of early (<10 minutes vs >10 minutes) pre-hospital adrenaline administration CPC 1-2



Study ID	RR (95% CI)	% Weight
shockable		
Hayashi 2018[18]	5.44 (3.00, 9.87)	1.99
Tanaka 2016[21]	3.60 (2.52, 5.13)	11.93
Hubble 2017[36]	2.67 (1.88, 3.80)	17.00
Subtotal (I-squared = 55.2%, p = 0.107)	3.21 (2.54, 4.05)	30.92
.		
Non-shockable		
Nakahara 2012[37]	1.17 (0.48, 2.84)	8.23
Hayashi 2018[18]	1.87 (0.12, 30.24)	0.50
Hubble 2017[36]	1.13 (0.27, 4.62)	3.17
Funada 2018[35]	1.67 (1.23, 2.25)	57.18
Subtotal (I-squared = 0.0%, p = 0.851)	1.58 (1.20, 2.09)	69.08
.		
Overall (I-squared = 76.5%, p = 0.000)	2.09 (1.73, 2.52)	100.00

CONGRESSO
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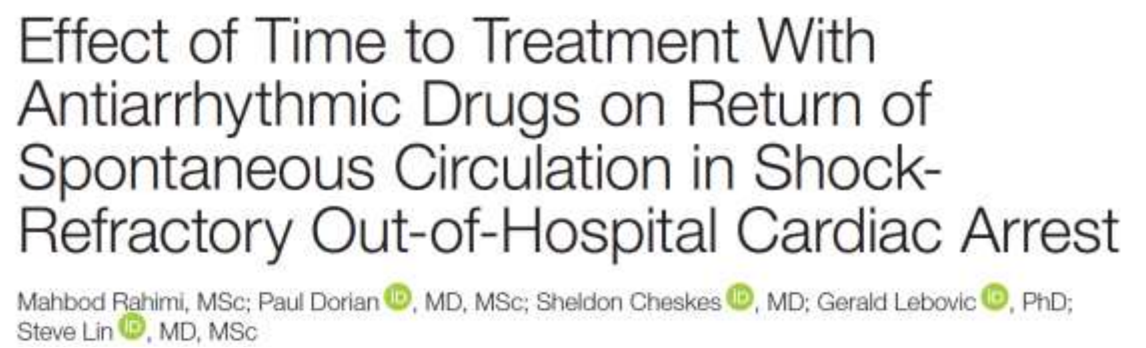


Effect of Time to Treatment With Antiarrhythmic Drugs on Return of Spontaneous Circulation in Shock-Refractory Out-of-Hospital Cardiac Arrest

Mahbod Rahimi, MSc; Paul Dorian, MD, MSc; Sheldon Cheskes, MD; Gerald Lebovic, PhD; Steve Lin, MD, MSc

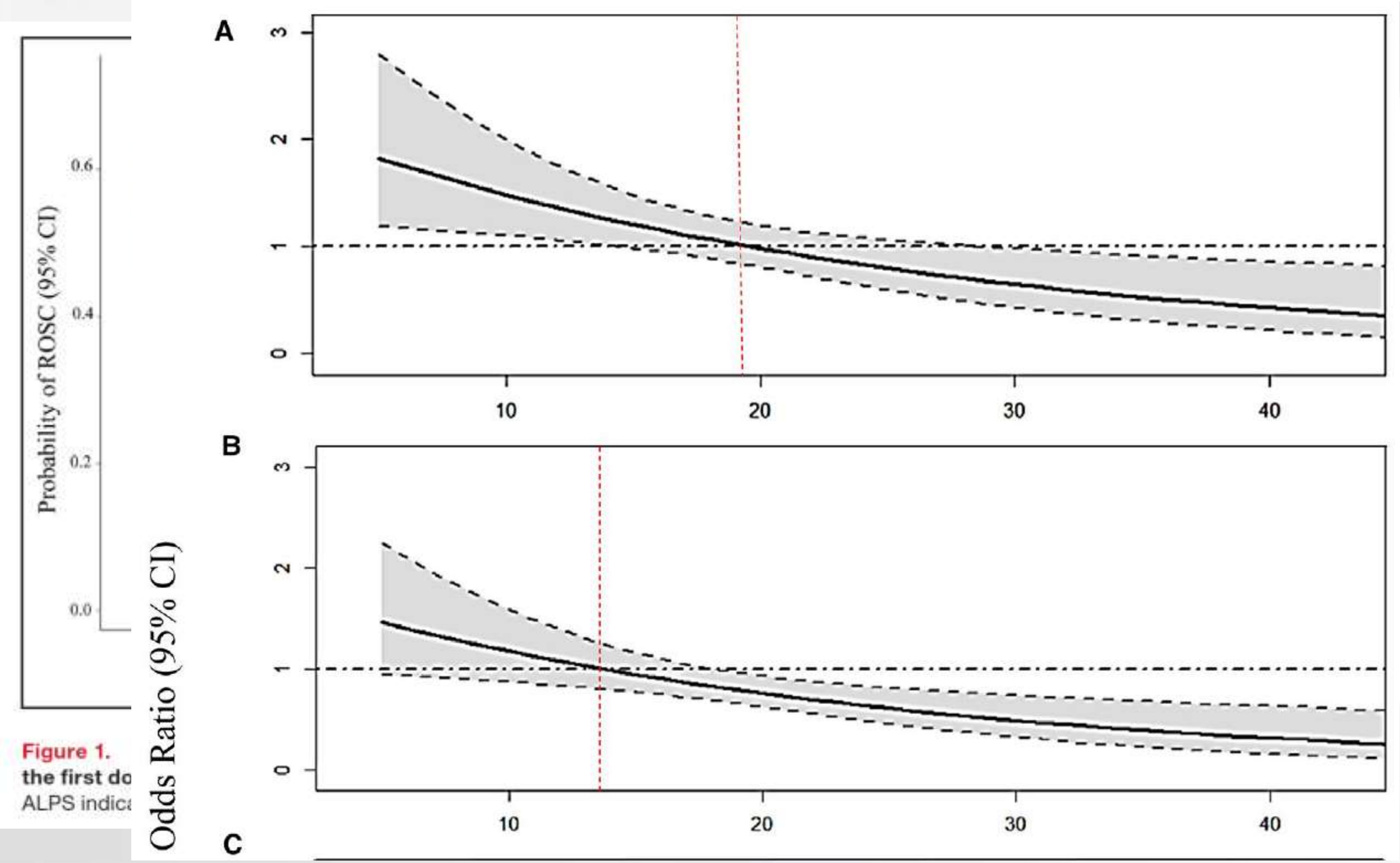


Figure 1.
the first do
ALPS indic

Amiodarone vs. placebo

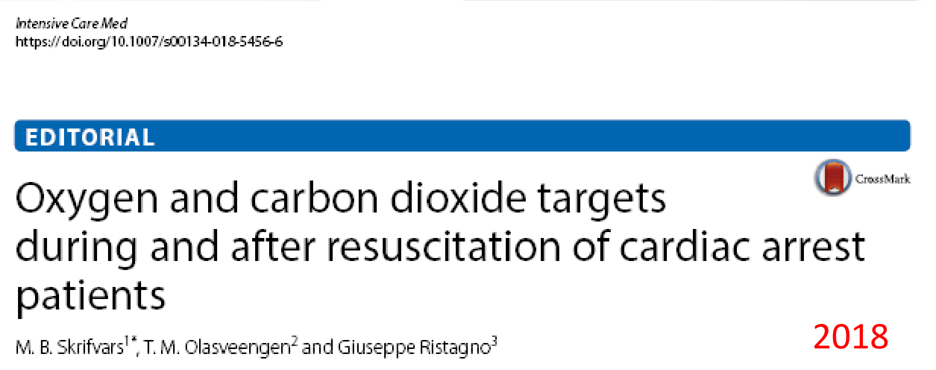
Amiodarone vs. lidocaine

IRC Italian Resuscitation Council

J Am Heart Assoc. 2022

After ROSC

- Use an ABCDE approach
- Aim for SpO_2 of 94-98% and normal $PaCO_2$
- 12 Lead ECG
- Identify and treat cause
- Targeted temperature management



Intensive Care Med
https://doi.org/10.1007/s00134-018-5456-6

EDITORIAL

Oxygen and carbon dioxide targets during and after resuscitation of cardiac arrest patients

M. B. Skrifvars[1*], T. M. Olasveengen[2] and Giuseppe Ristagno[3]

2018

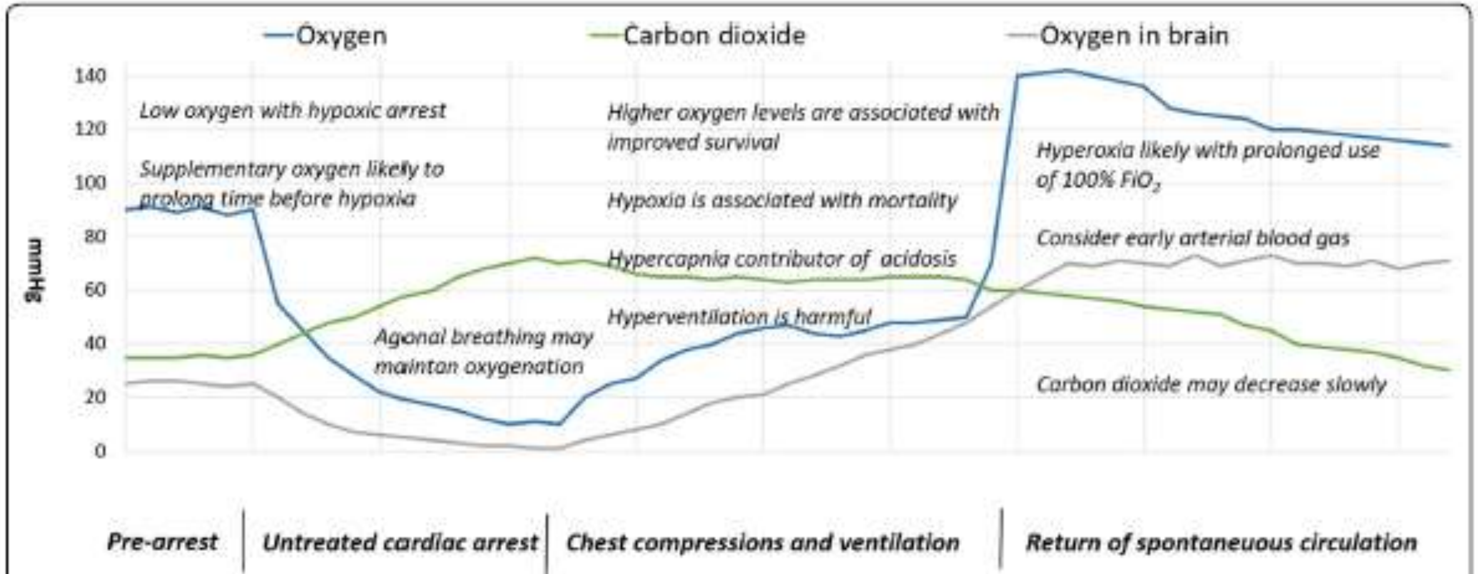
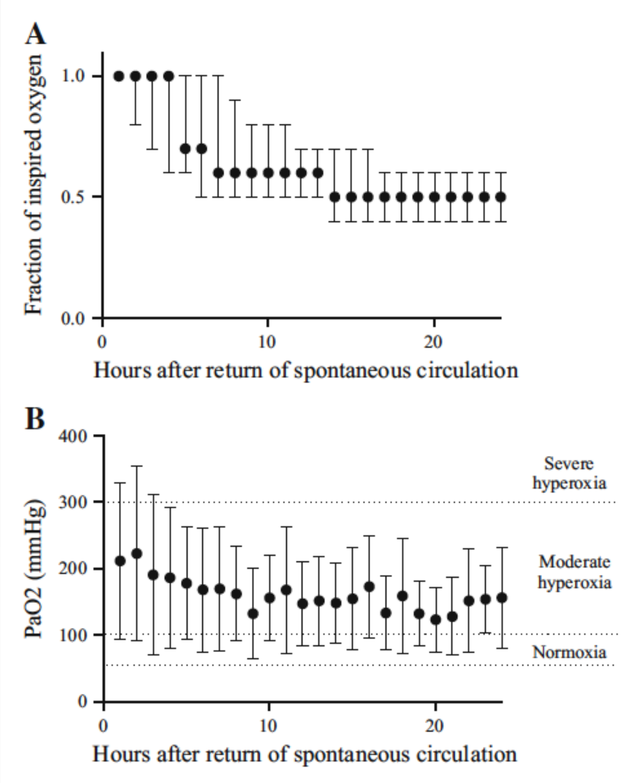
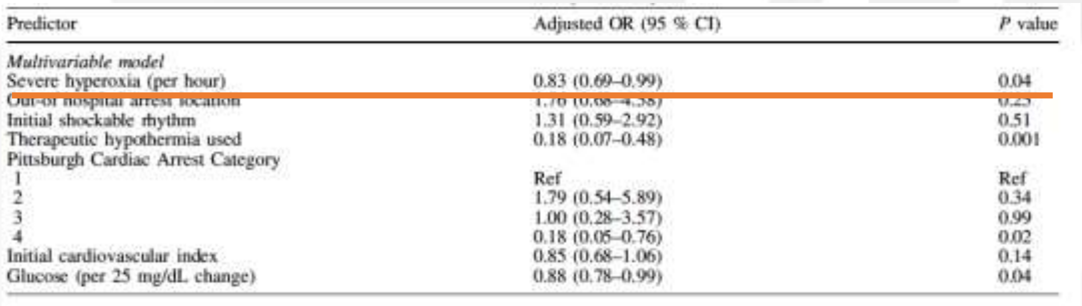


Fig. 1 An approximate depiction of changes in oxygen and carbon dioxide in the arterial blood as well as oxygen in brain tissue before with management aspects, during and immediately after cardiac arrest

Retrospective analysis of a singlecenter, prospective registry of 184 consecutive cardiac arrest patients

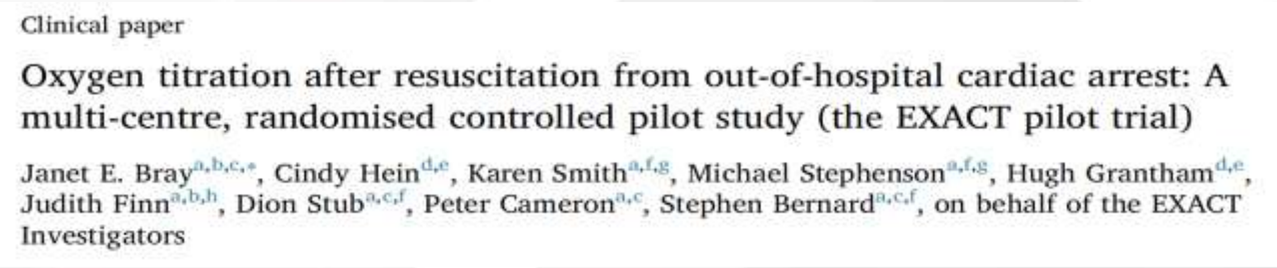




Predictor	Adjusted OR (95 % CI)	*P* value
Multivariable model		
Severe hyperoxia (per hour)	0.83 (0.69–0.99)	0.04
Out-of hospital arrest location	1.76 (0.68–4.58)	0.25
Initial shockable rhythm	1.31 (0.59–2.92)	0.51
Therapeutic hypothermia used	0.18 (0.07–0.48)	0.001
Pittsburgh Cardiac Arrest Category		
1	Ref	Ref
2	1.79 (0.54–5.89)	0.34
3	1.00 (0.28–3.57)	0.99
4	0.18 (0.05–0.76)	0.02
Initial cardiovascular index	0.85 (0.68–1.06)	0.14
Glucose (per 25 mg/dL change)	0.88 (0.78–0.99)	0.04

Intensive Care Med (2015) 41:49–57
DOI 10.1007/s00134-014-3555-6

Resuscitation 128 (2018) 211–215



Clinical paper

Oxygen titration after resuscitation from out-of-hospital cardiac arrest: A multi-centre, randomised controlled pilot study (the EXACT pilot trial)

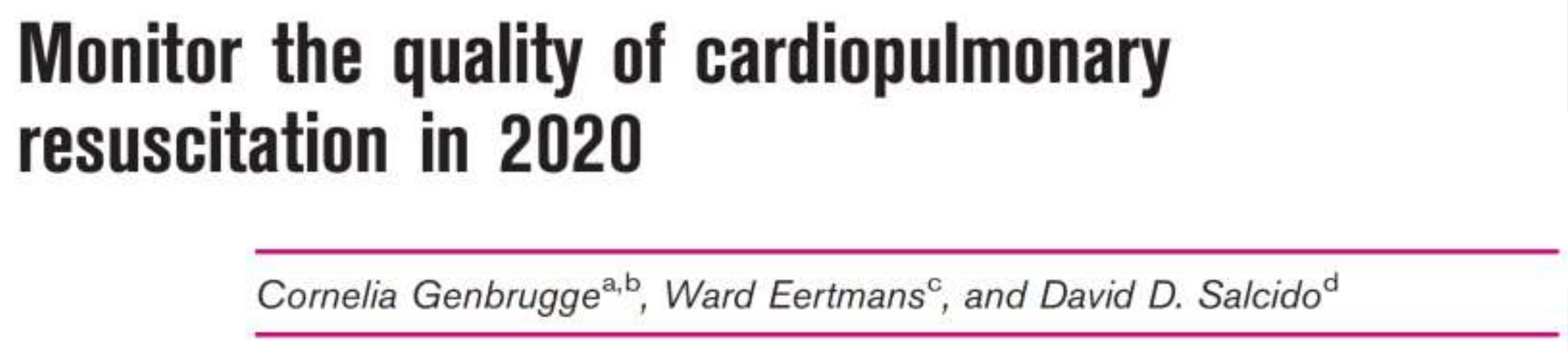
Janet E. Bray[a,b,c,*], Cindy Hein[d,e], Karen Smith[a,f,g], Michael Stephenson[a,f,g], Hugh Grantham[d,e], Judith Finn[a,b,h], Dion Stub[a,c,f], Peter Cameron[a,c], Stephen Bernard[a,c,f], on behalf of the EXACT Investigators

Clinical paper

The EXACT protocol: A multi-centre, single-blind, randomised, parallel-group, controlled trial to determine whether early oxygen titration improves survival to hospital discharge in adult OHCA patients

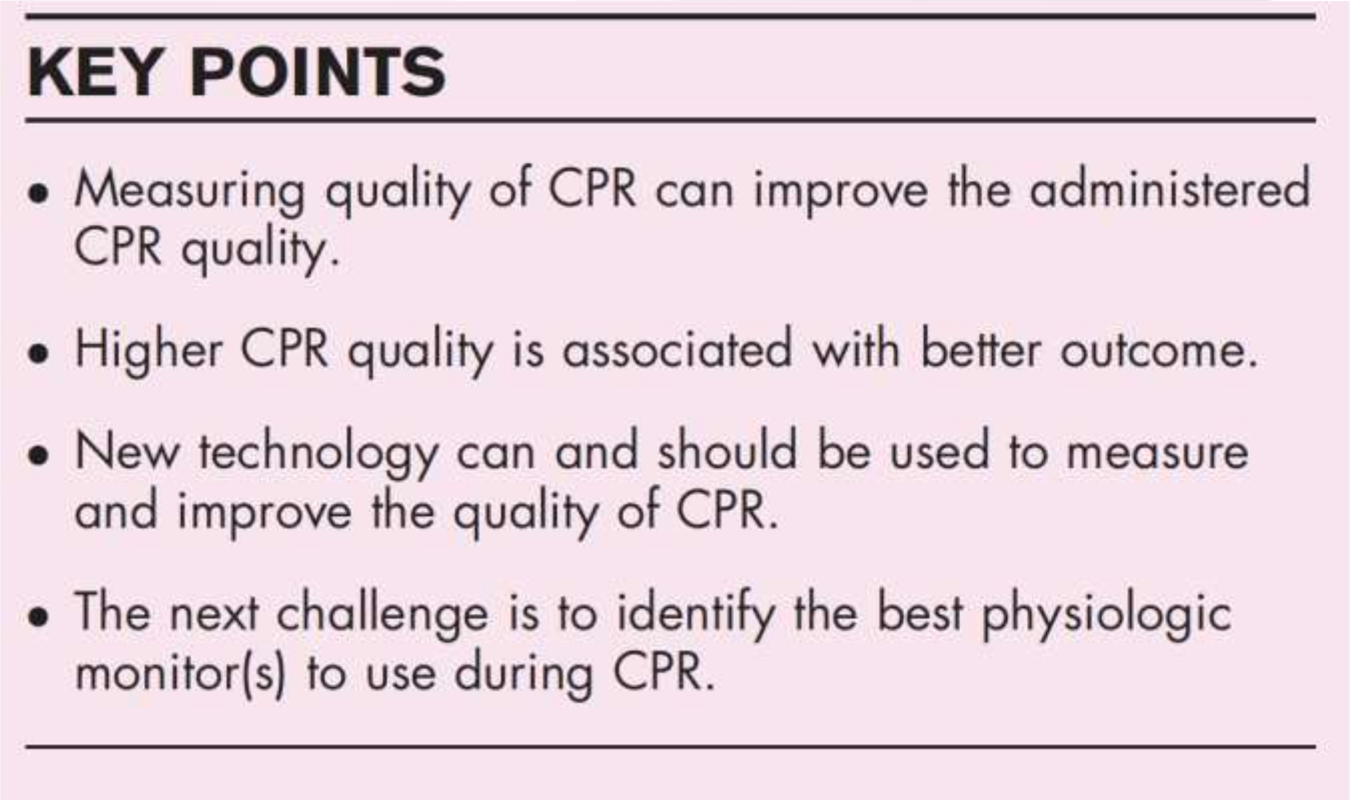
Janet E. Bray[a,b,c], Karen Smith[a,d,e], Cindy Hein[f,g], Judith Finn[a,b,h,i], Michael Stephenson[a,d,e], Peter Cameron[a,c], Dion Stub[a,c,d], Gavin D Perkins[a,j], Hugh Grantham[b,f], Paul Bailey[b,h], Deon Brink[b,h], Natasha Dodge[a], Stephen Bernard[a,c,d,], on behalf of the EXACT investigators*

> 1600 OHCA with advanced airway and have an oxygen saturation (SpO2) 95% on >10 L/min (or 100% oxygen).



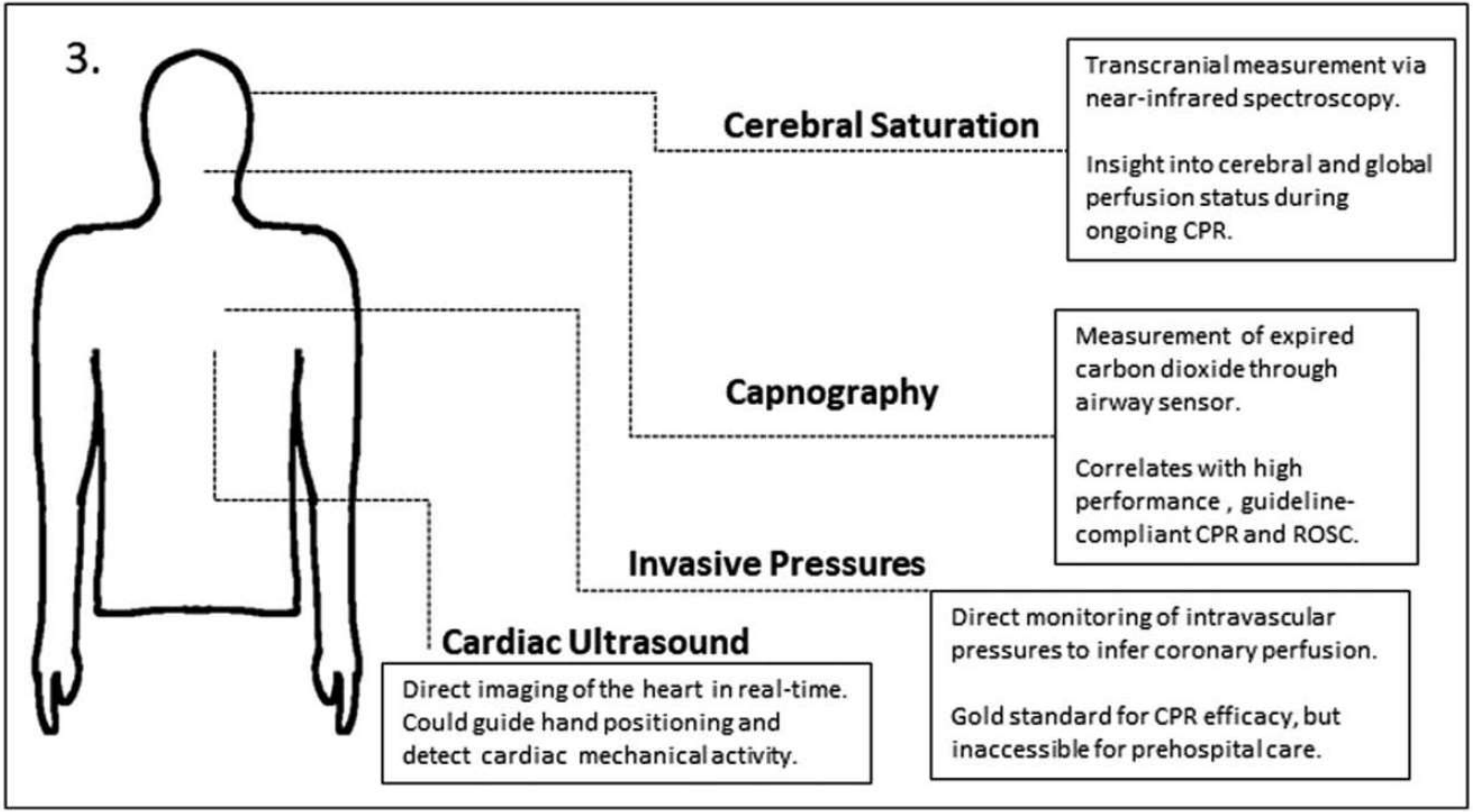
Monitor the quality of cardiopulmonary resuscitation in 2020

Cornelia Genbrugge[a,b], Ward Eertmans[c], and David D. Salcido[d]



KEY POINTS

- Measuring quality of CPR can improve the administered CPR quality.
- Higher CPR quality is associated with better outcome.
- New technology can and should be used to measure and improve the quality of CPR.
- The next challenge is to identify the best physiologic monitor(s) to use during CPR.



3.

Cerebral Saturation

Transcranial measurement via near-infrared spectroscopy.

Insight into cerebral and global perfusion status during ongoing CPR.

Capnography

Measurement of expired carbon dioxide through airway sensor.

Correlates with high performance, guideline-compliant CPR and ROSC.

Invasive Pressures

Direct monitoring of intravascular pressures to infer coronary perfusion.

Gold standard for CPR efficacy, but inaccessible for prehospital care.

Cardiac Ultrasound

Direct imaging of the heart in real-time. Could guide hand positioning and detect cardiac mechanical activity.

What’s next?

Italian Resuscitation Council

♡♡♡.ircouncil.it