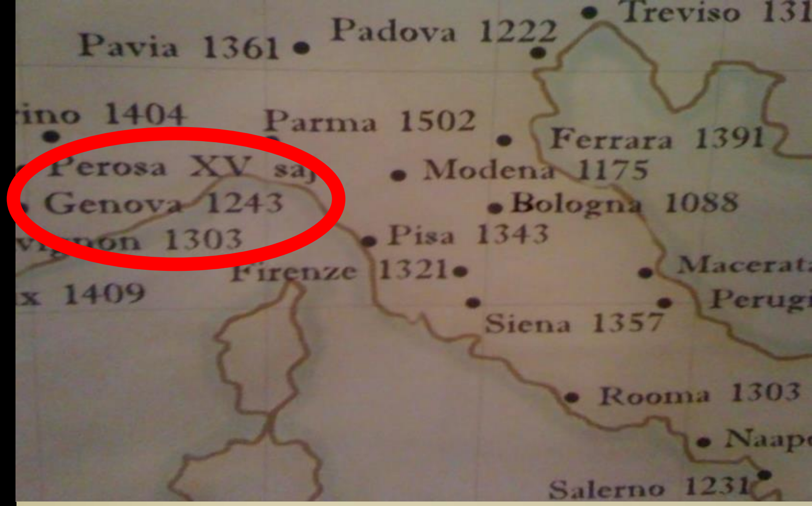

The current challanges after cardiac arrest: post-cardiac arrest management?

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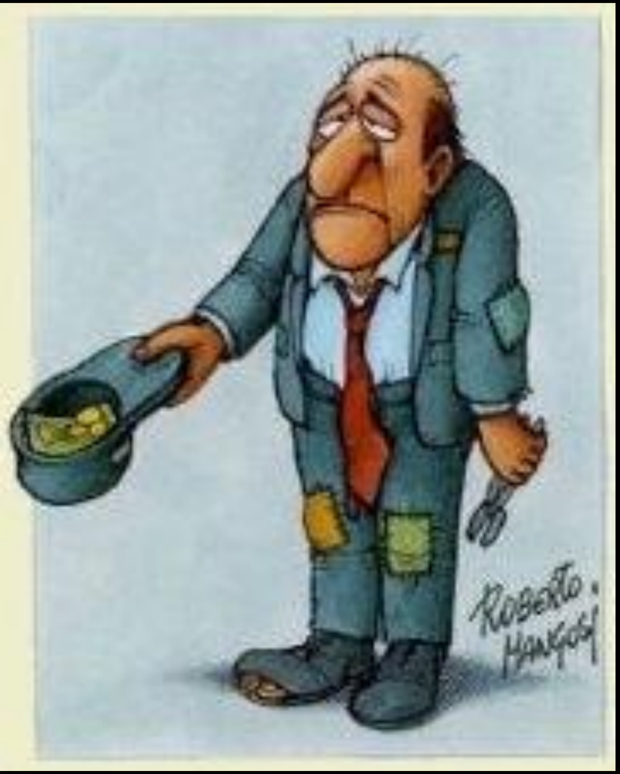
KARPACZ, 24–26 November 2016

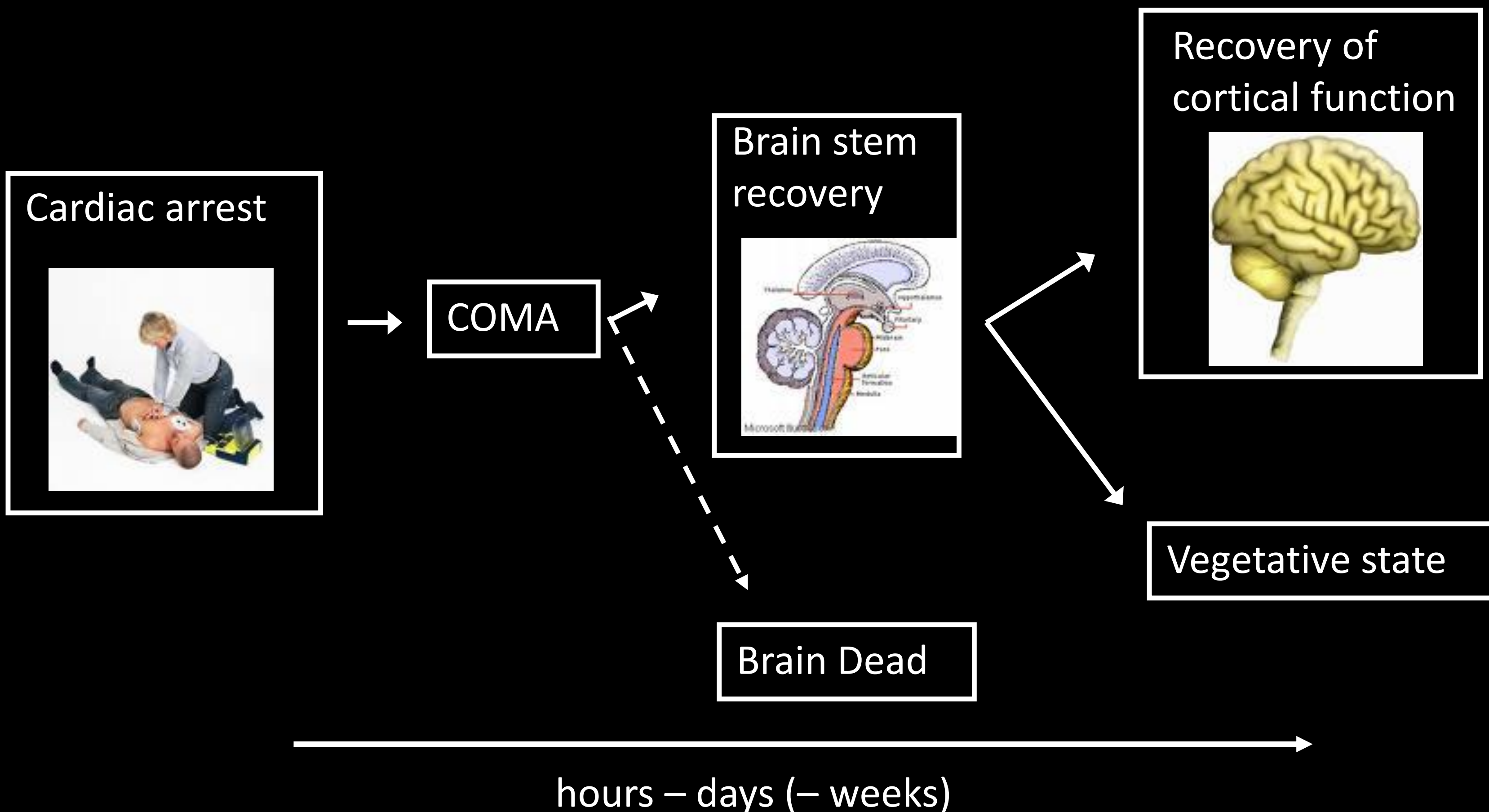
Conflicts of Interest

I declare
NO conflicts of interest



Natural course of neurological recovery following cardiac arrest

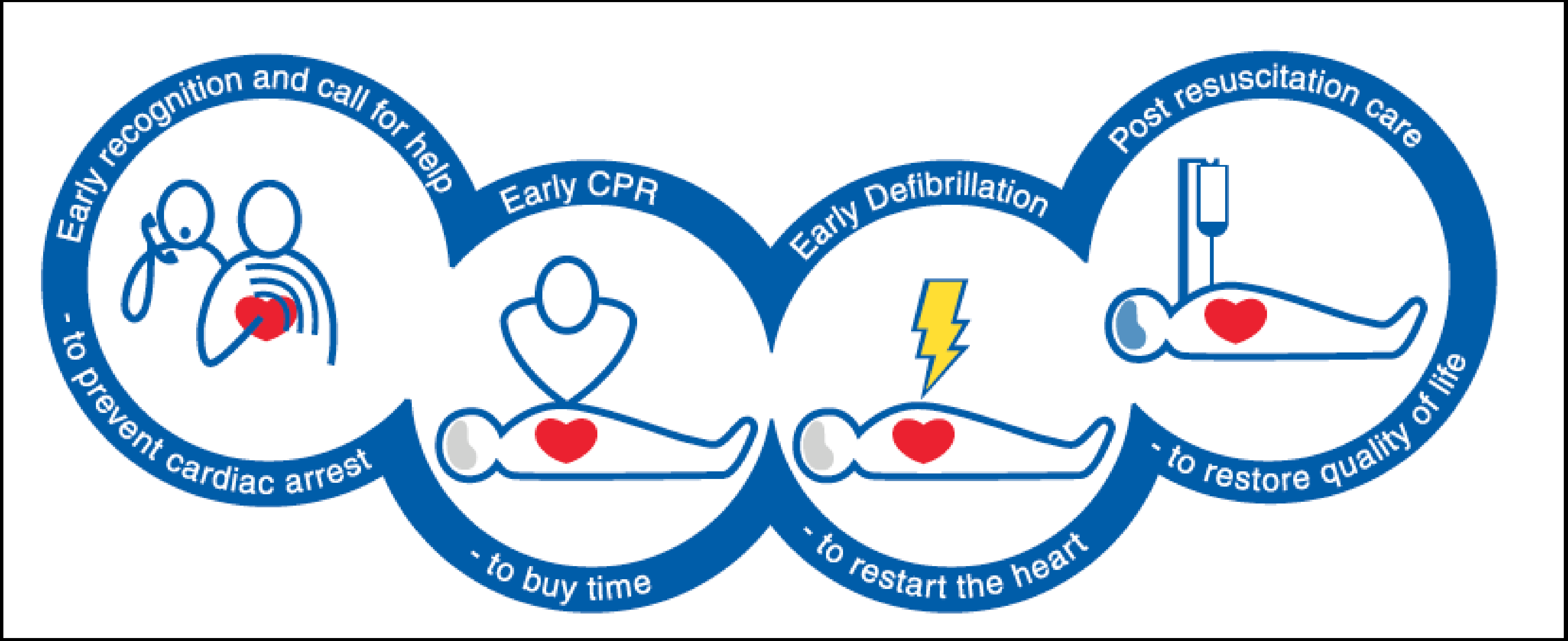
Patil KD et al. Circ Res. 2015 Jun 5;116(12):2041-9



The “Chain“ of Survival

Pekins GD et al Resuscitation 95 (2015): 81-99

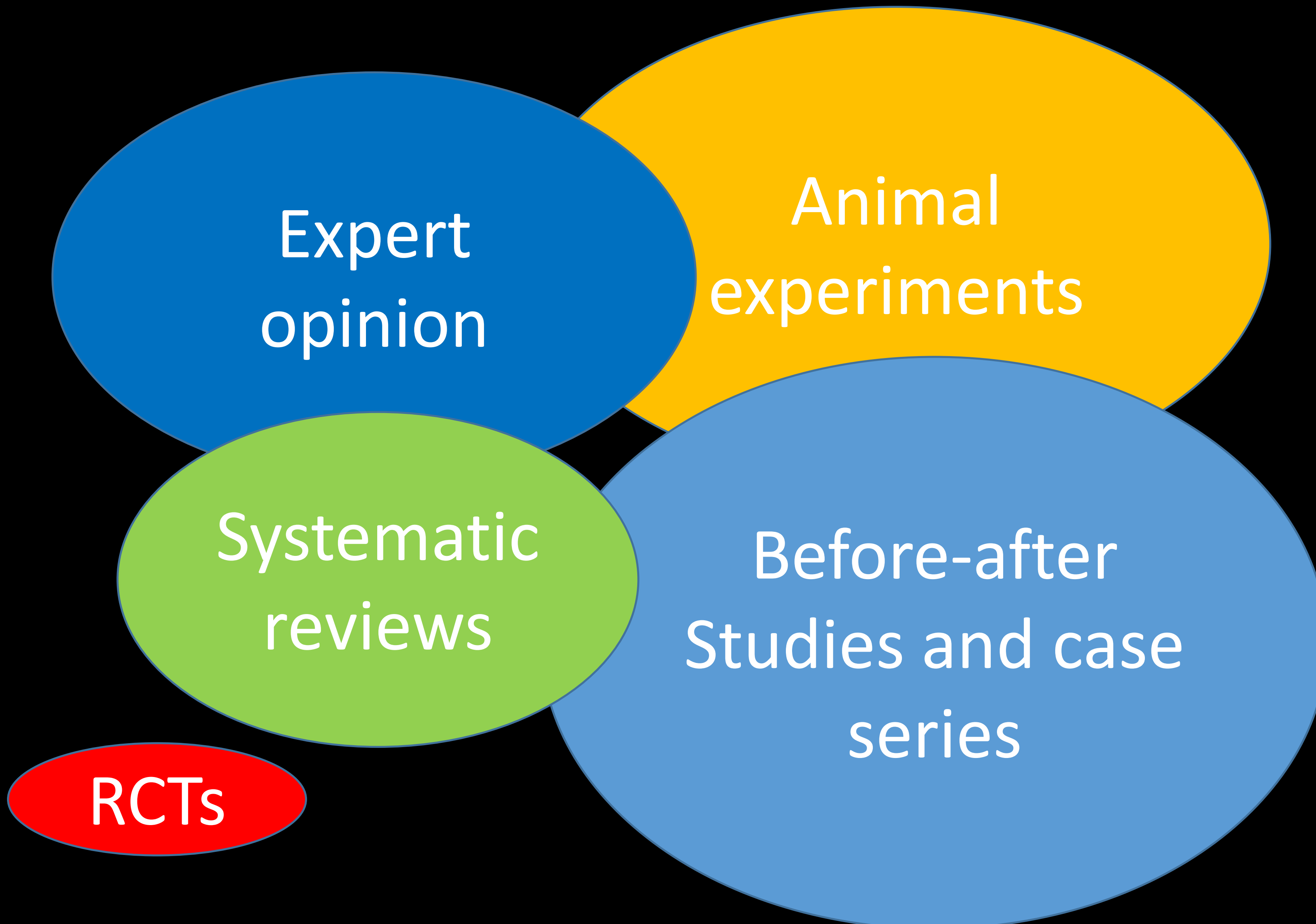
Sutherasan Y et al. Best Pract Res Clin Anaesthesiol. 2015 Dec;29(4):411-2



The current challenges of cardiac arrest:
Post cardiac arrest management

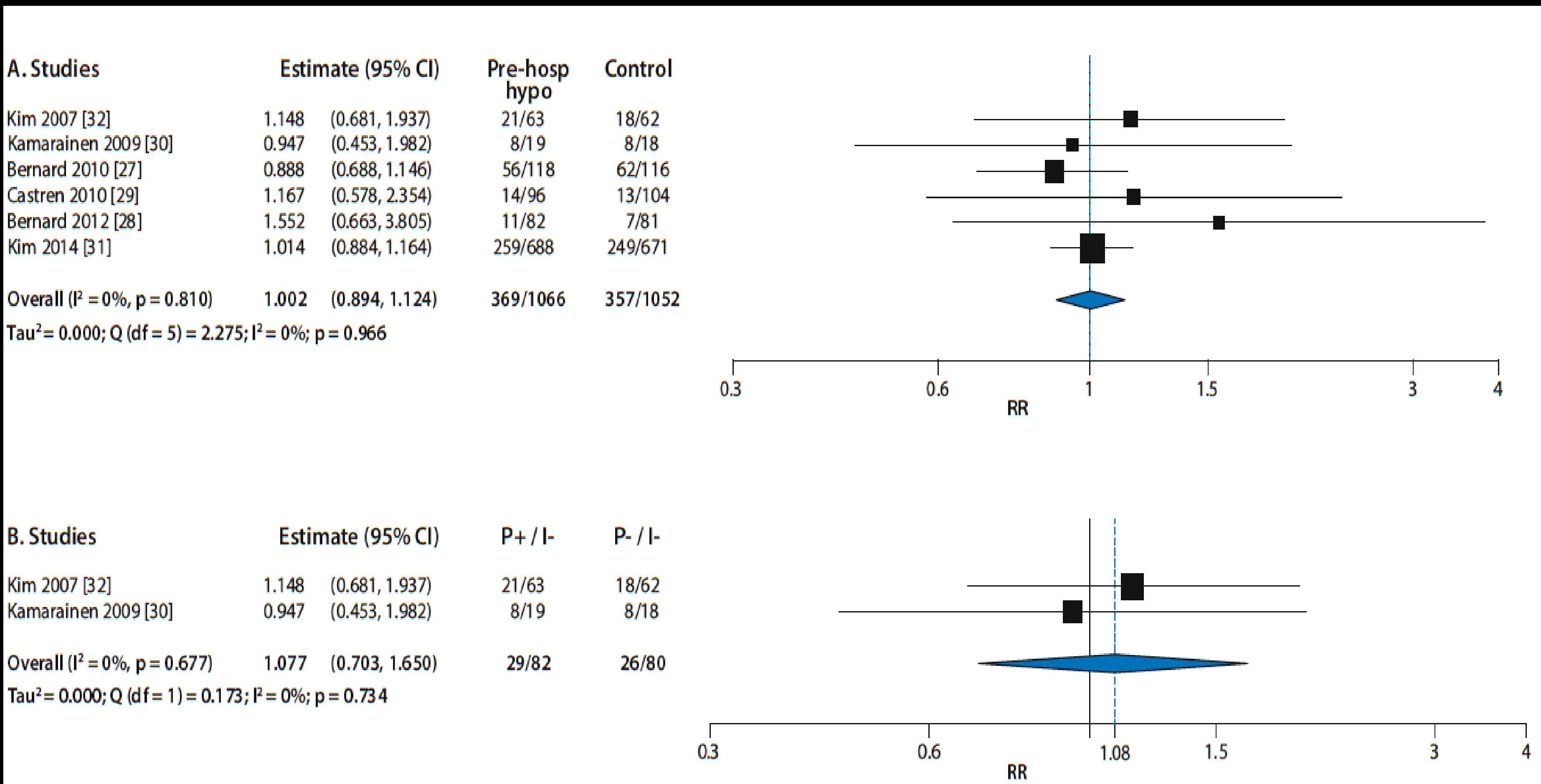
Mild to Moderate Hypothermia in Out-of-Hospital Cardiac Arrest

Evidence for TTM for cardiac arrest



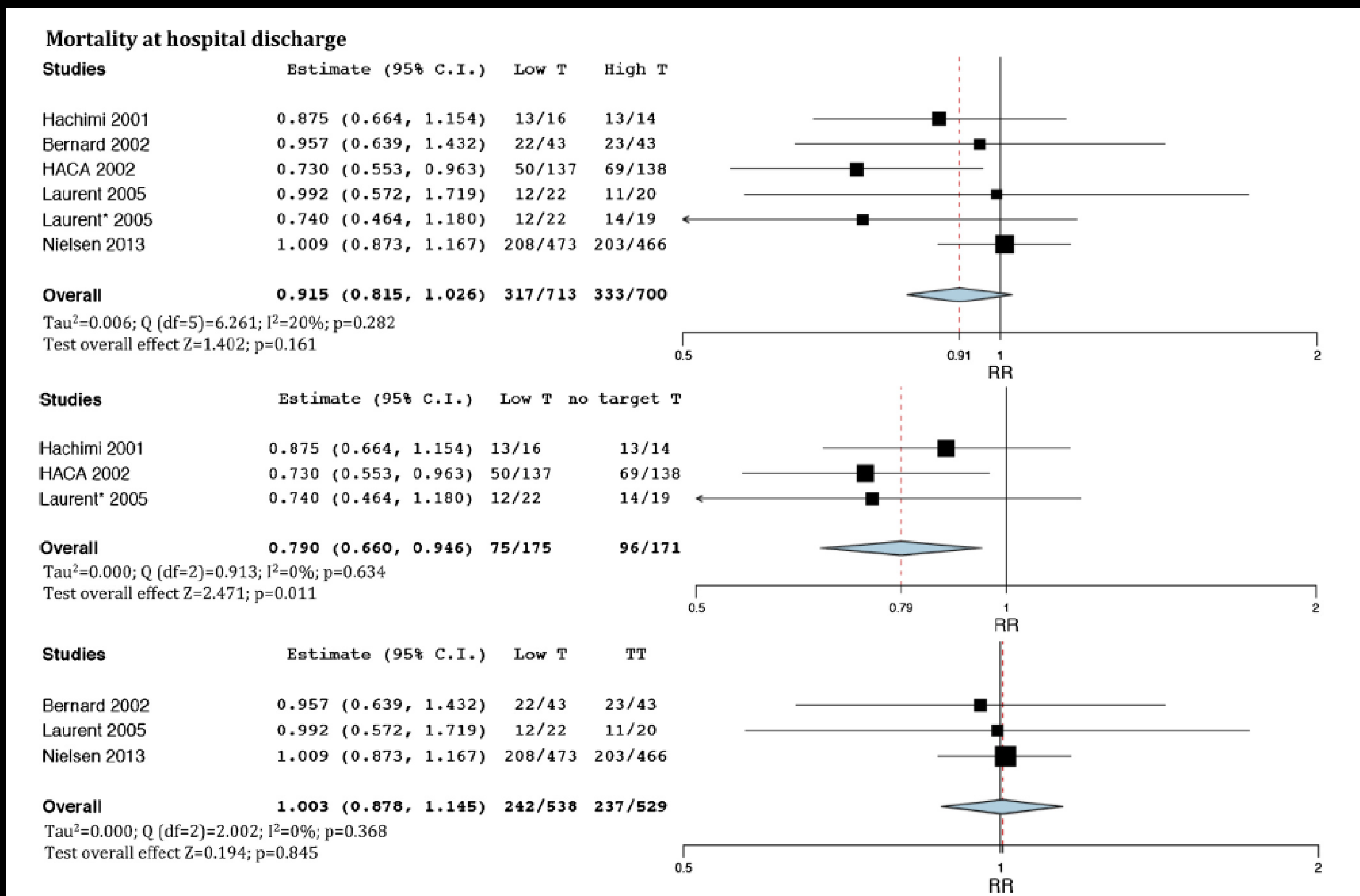
Pre-Hospital Hypothermia: Survival to Hospital Discharge

Vargas M et al. Annual Update in Intensive Care and Emergency Medicine, Springer Verlag, J.-L. Vincent (ed.), 2015 pp 289-314



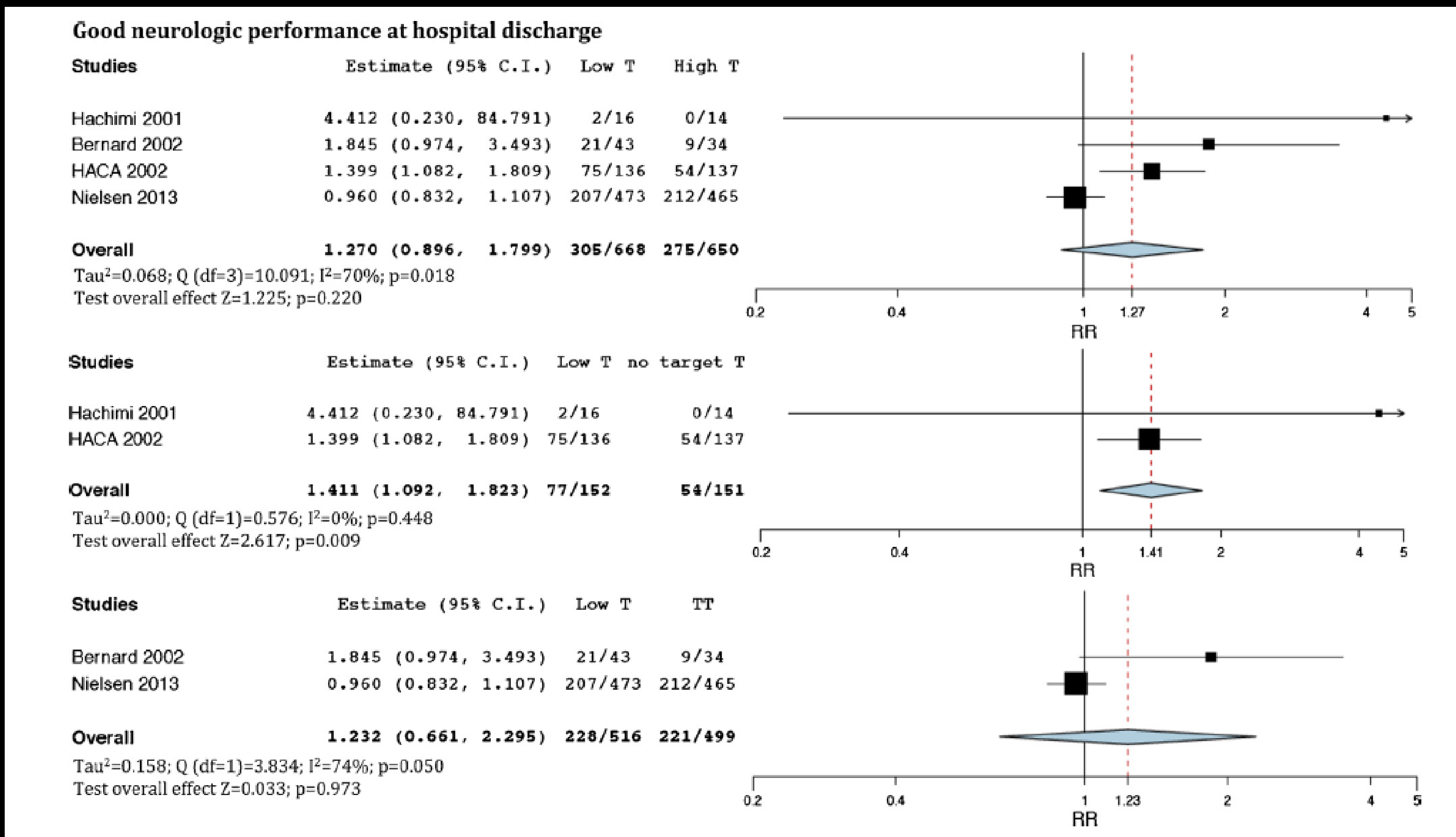
Effects of in-hospital low targeted temperature after out of hospital cardiac arrest: A systematic review with meta-analysis of RCTs

Vargas M et al. Resuscitation. 2015 Jun; 91:8-18



Effects of in-hospital low targeted temperature after out of hospital cardiac arrest: A systematic review with meta-analysis of RCTs

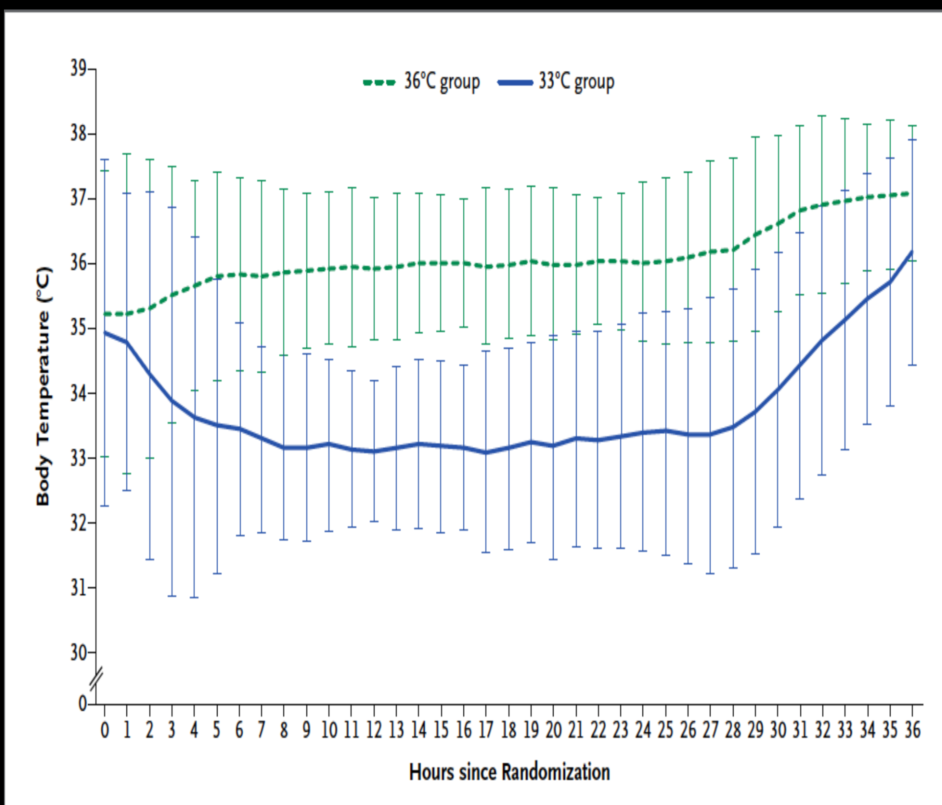
Vargas M et al. Resuscitation. 2015 Jun; 91:8-18

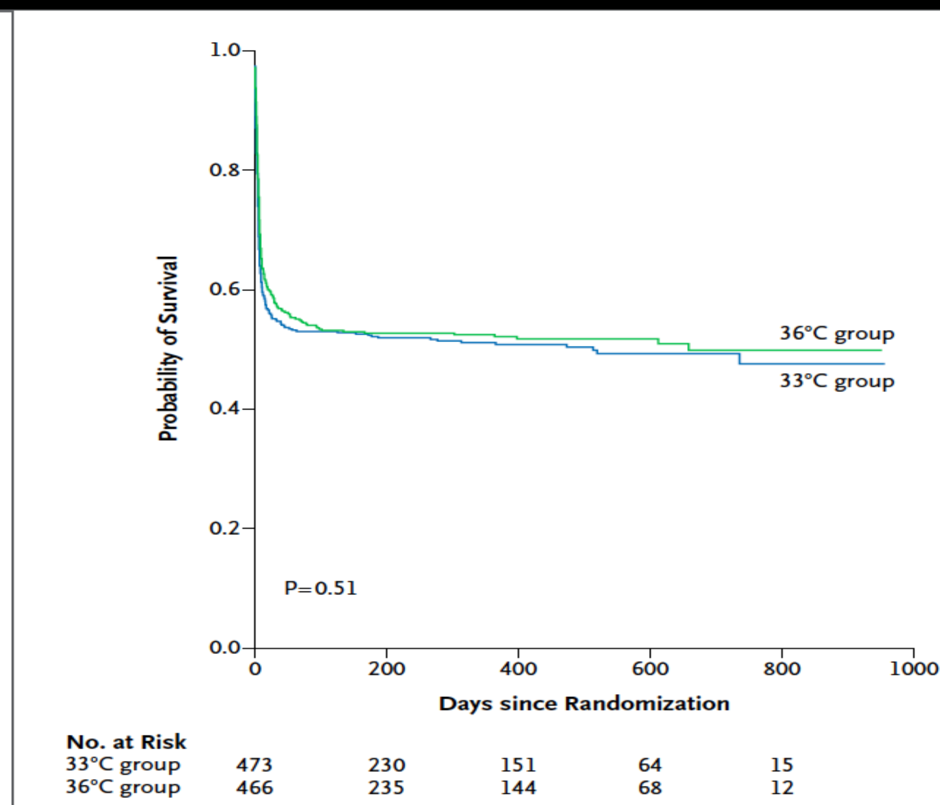


ORIGINAL ARTICLE

Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

Nilsen N et al. Engl J Med 2013;369:2197-206





The problem with TTM trial

- It did not add at all evidence level for hypothermia “PER SE” after cardiac arrest
- Both groups were temperature managed to levels below the ”wild type” temperature

ORIGINAL ARTICLE

Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

The two largest misconceptions with the TTM trial

- The TTM trial showed that target temperature management does not work, is unnecessary and could be abandoned

- The TTM-trial showed the importance of avoiding fever in cardiac arrest

ORIGINAL ARTICLE

Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

What TTM trial did show ?

- Two strictly controlled temperature management regiments do not give different results

ILCOR Advisory statement 2015

- 1 RCT and 1 quasi RCT provide **overall low quality evidence** to use TTM after ROSC from OHCA with initial shockable rhythm
- **There is no good evidence** that suggests that one target temperature within 32 °C to 36 °C range is superior to another

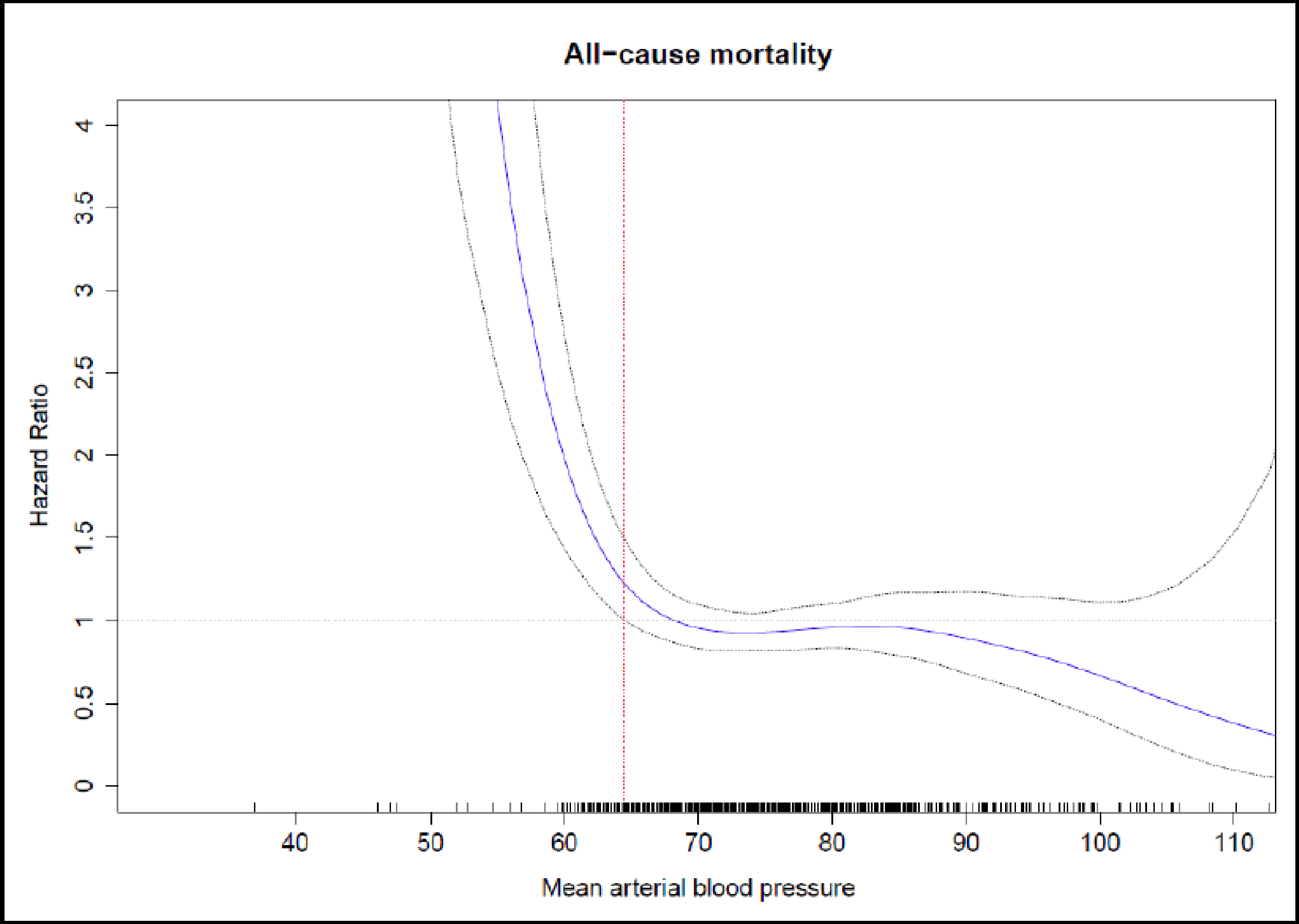
ORIGINAL ARTICLE

Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

Hemodynamics and Vasopressor Support in Out-of-hospital Cardiac Arrest

Hemodynamics and vasopressor support at two target temperatures after cardiac arrest

Bro-Jeppesen J et al. Crit Care Med. 2015 Feb;43(2):318-27



Hemodynamics and vasopressor support at two target temperatures after cardiac arrest

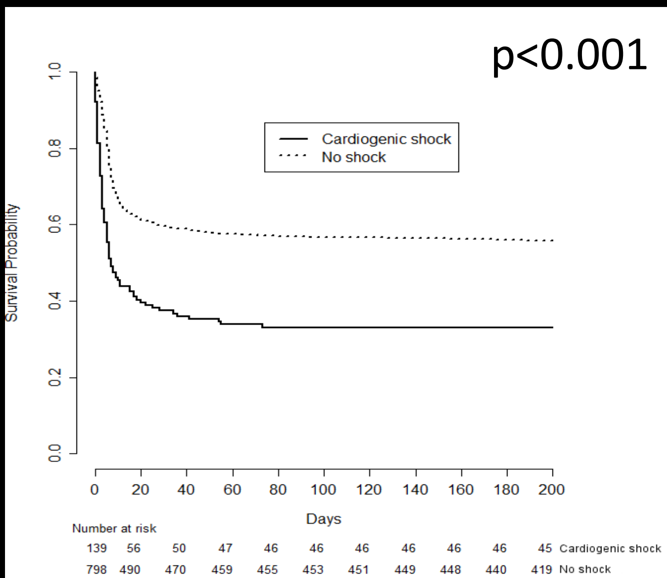
Bro-Jeppesen J et al. Crit Care Med. 2015 Feb;43(2):318-27

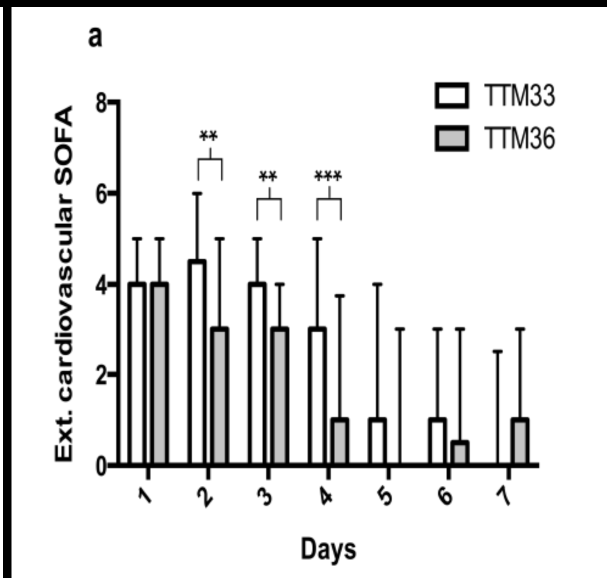
PREDICTORS OF NEED FOR HIGH VASOPRESSORS

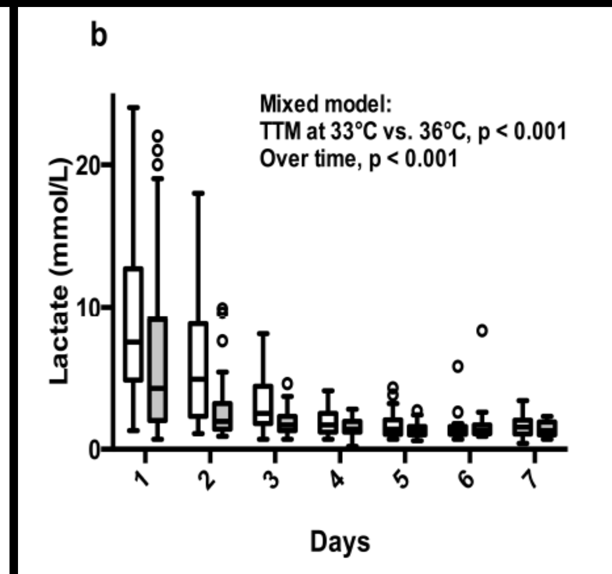
	Univariable		Multivariable	
	OR (95 % CI)	p-value	OR (95 % CI)	p-value
TTM group, 33° vs. 36°	1.38 (1.07-1.79)	0.01	1.51 (1.14-2.00)	0.004
Sex, male vs. Female	0.95 (0.68-1.33)	0.77		
Age, per 5 years	1.14 (1.08-1.20)	<0.0001	1.13 (1.07-1.20)	<0.0001
Witnessed arrest, yes vs. no	1.42 (0.93-2.17)	0.11		
Bystander CPR, yes vs. no	0.54 (0.40-0.73)	0.0001	0.63 (0.46-0.87)	0.005
Initial rhythm, shockable vs. not shockable	0.54 (0.39-0.76)	0.0003		
Time to ROSC, per 5 minutes	1.09 (1.06-1.13)	<0.0001	1.07 (1.04-1.11)	<0.0001
Initial lactate, per 5 mmol/L	1.52 (1.29-1.79)	<0.0001	1.38 (1.17-1.65)	0.0002

The association of TTM at 33°C versus 36°C with outcome in patients with moderate shock on admission after OHCA – TTM substudy

Annborn M et al. Intensive Care Med. 2014 Sep;40(9):1210-9



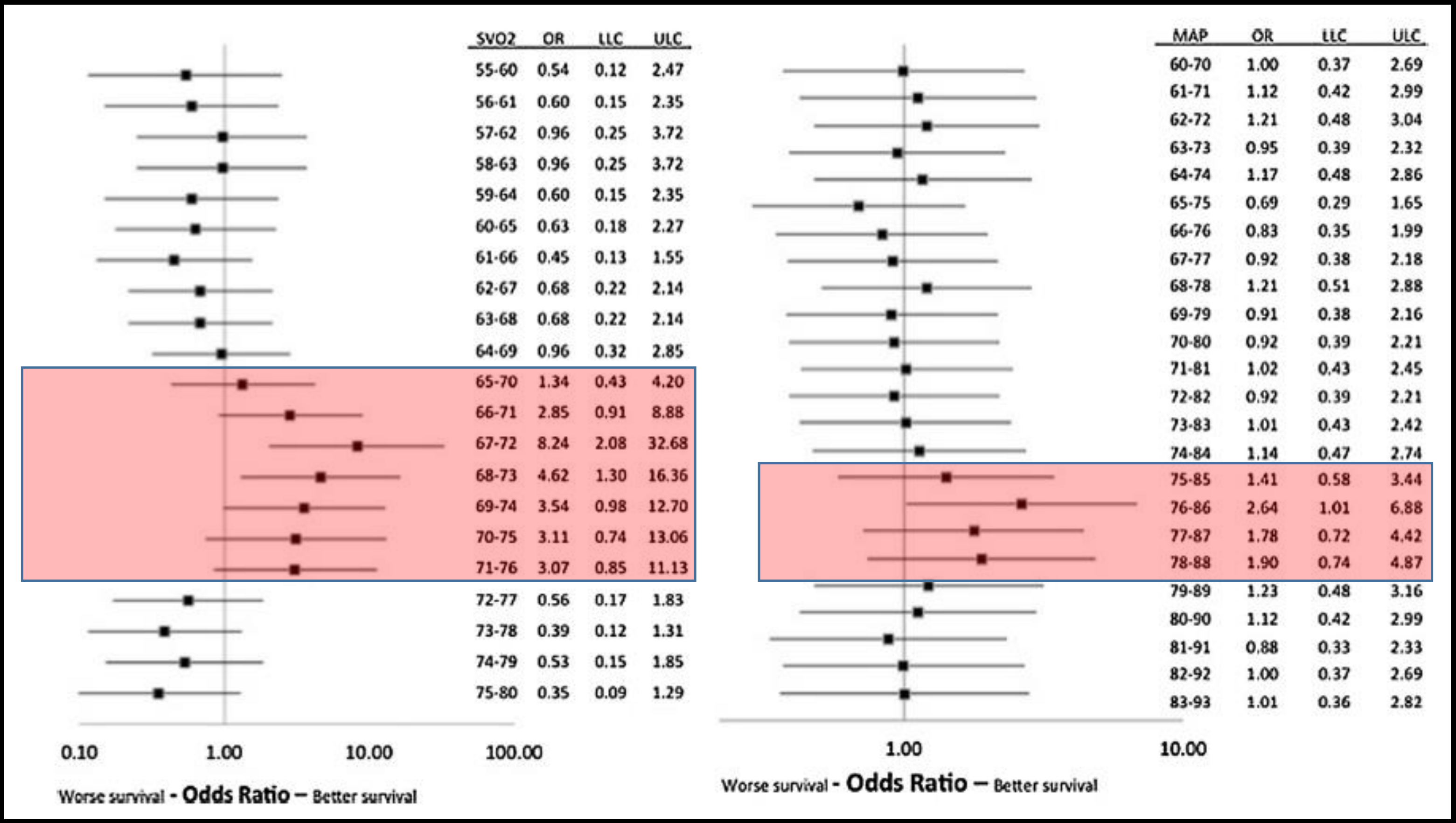




Variable	OR (95 % CI)	*p* value
Targeted temperature management at 33 °C	1.46 (0.60–3.56)	0.40
Age (per years)	1.04 (0.97–1.09)	0.07
Previous cardiac disease[a]	1.36 (0.46–3.99)	0.58
Non-shockable rhythm[b]	23.1 (2.99–178.6)	0.003
Time to ROSC (per min)[c]	1.02 (1.002–1.034)	0.027
Successful PCI	0.43 (0.16–1.14)	0.09

Hemodynamic targets during therapeutic hypothermia after cardiac arrest: A prospective observational study

Ameloot K et al. Resuscitation 91: 56-62 (2015)



SVO2	OR	LLC	ULC
55-60	0.54	0.12	2.47
56-61	0.60	0.15	2.35
57-62	0.96	0.25	3.72
58-63	0.96	0.25	3.72
59-64	0.60	0.15	2.35
60-65	0.63	0.18	2.27
61-66	0.45	0.13	1.55
62-67	0.68	0.22	2.14
63-68	0.68	0.22	2.14
64-69	0.96	0.32	2.85
65-70	1.34	0.43	4.20
66-71	2.85	0.91	8.88
67-72	8.24	2.08	32.68
68-73	4.62	1.30	16.36
69-74	3.54	0.98	12.70
70-75	3.11	0.74	13.06
71-76	3.07	0.85	11.13
72-77	0.56	0.17	1.83
73-78	0.39	0.12	1.31
74-79	0.53	0.15	1.85
75-80	0.35	0.09	1.29

MAP	OR	LLC	ULC
60-70	1.00	0.37	2.69
61-71	1.12	0.42	2.99
62-72	1.21	0.48	3.04
63-73	0.95	0.39	2.32
64-74	1.17	0.48	2.86
65-75	0.69	0.29	1.65
66-76	0.83	0.35	1.99
67-77	0.92	0.38	2.18
68-78	1.21	0.51	2.88
69-79	0.91	0.38	2.16
70-80	0.92	0.39	2.21
71-81	1.02	0.43	2.45
72-82	0.92	0.39	2.21
73-83	1.01	0.43	2.42
74-84	1.14	0.47	2.74
75-85	1.41	0.58	3.44
76-86	2.64	1.01	6.88
77-87	1.78	0.72	4.42
78-88	1.90	0.74	4.87
79-89	1.23	0.48	3.16
80-90	1.12	0.42	2.99
81-91	0.88	0.33	2.33
82-92	1.00	0.37	2.69
83-93	1.01	0.36	2.82

SvO_2 = 65-75% **MAP = 75-88 mmHg**

Cardiac arrest

Recommendations	Class	Level
All medical and paramedical personnel caring for a patient with suspected myocardial infarction must have access to defibrillation equipment and be trained in cardiac life support.	I	C
It is recommended to initiate ECG monitoring at the point of FMC in all patients with suspected myocardial infarction.	I	C
Therapeutic hypothermia is indicated early after resuscitation of cardiac arrest patients who are comatose or in deep sedation.	I	B
Immediate angiography with a view to primary PCI is recommended in patients with resuscitated cardiac arrest whose ECG shows STEMI.	I	B
Immediate angiography with a view to primary PCI should be considered in survivors of cardiac arrest without diagnostic ECG ST-segment elevation but with a high suspicion of ongoing infarction.	IIa	B

ECG = electrocardiogram; FMC = first medical contacts; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.

European Heart Journal (2012) 33, 2569–2619
doi:10.1093/eurheartj/ehs215

Normoxia, Hypoxia, Hyperoxia and CO_2 in Out-of-Hospital Cardiac Arrest

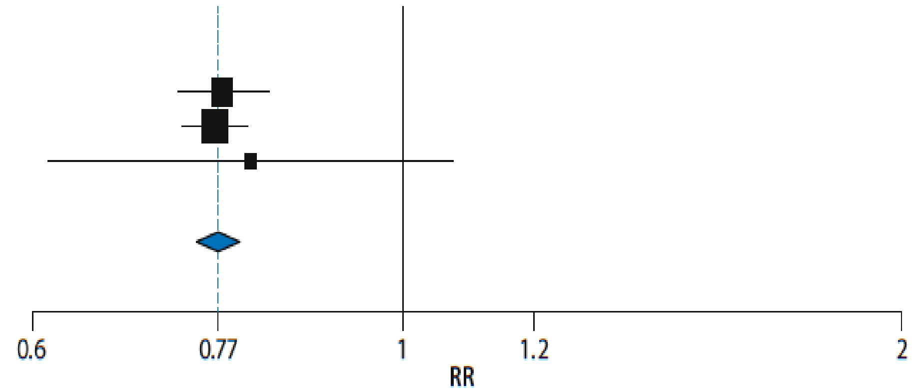
Effects of Normoxia vs Hyperoxia (>300 mmHg) & Hypoxia (< 60 mmHg) on In-hospital Mortality

Sutherasan Y et al. Minerva Anestesiol. 2015 Jan;81(1):39-51

Sutherasan Y etal. Best Pract Res Clin Anaesthesiol. 2015 Dec;29(4):413-24.

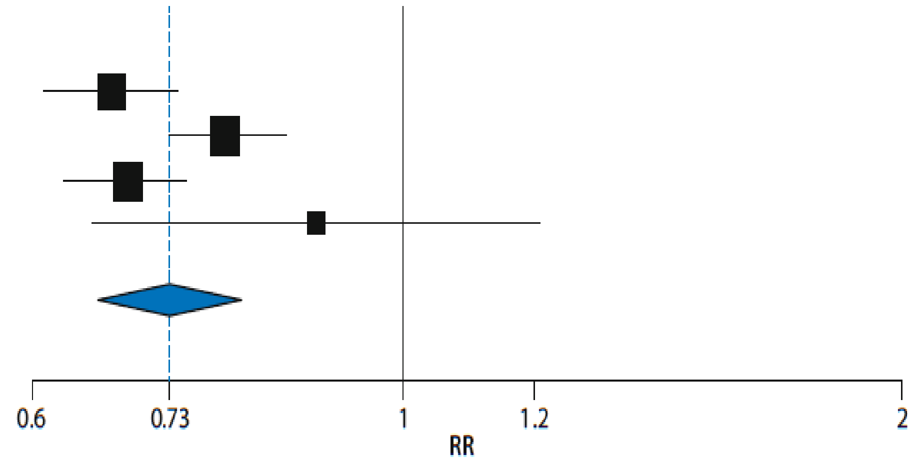
A. Studies	Estimate	(95% CI)	Hypoxia	Normoxia
Kilgannon 2010 [44]	0.780	(0.732, 0.831)	1702/3999	639/1171
Bellomo 2011 [45]	0.770	(0.733, 0.809)	3601/8904	1008/1919
Ihle 2013 [46]	0.808	(0.612, 1.068)	27/55	300/494
Overall (I^2 = 0%, p = 0.908)	0.774	(0.745, 0.805)	5330/12958	1947/3584

$Tau^2 = 0.000$; Q (df = 2) = 0.193; $I^2 = 0\%$; $p < 0.001$



B. Studies	Estimate	(95% CI)	Hyperoxia	Normoxia
Kilgannon 2010 [44]	0.672	(0.613, 0.737)	424/1156	639/1171
Bellomo 2011 [45]	0.787	(0.728, 0.850)	531/1285	1008/1919
Kilgannon 2011 [43]	0.687	(0.635, 0.745)	510/1525	1430/2939
Ihle 2013 [46]	0.894	(0.654, 1.221)	19/35	300/494
Overall (I^2 = 71%, p = 0.017)	0.727	(0.660, 0.802)	1484/4001	3377/6523

$Tau^2 = 0.006$; Q (df = 3) = 10.248; $I^2 = 71\%$; $p < 0.001$



Effect of Hypocapnia and Hypercapnia after CA

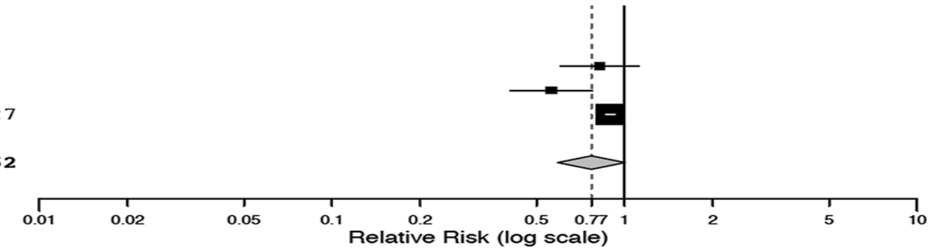
Sutherasan Y et al. Minerva Anestesiol. 2015 Jan;81(1):39-51

Sutherasan Y etal. Best Pract Res Clin Anaesthesiol. 2015 Dec;29(4):413-24.

Normocapnia and Hypocapnia on Mortality (Adults and Pediatrics)

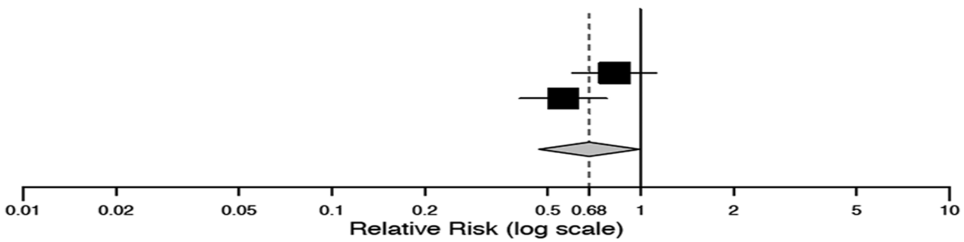
Adult+Pediatric	RR (95% CI)	Normo	Hyper
Bennett 2011	0.822 (0.604, 1.117)	30/57	41/64
De Castillo 2012	0.560 (0.406, 0.773)	43/130	36/61
Scheneider 2013	0.894 (0.867, 0.922)	3464/6705	3945/6827
Overall (I^2=76% , P=0.016)	**0.769 (0.590, 1.003)**	**3537/6892**	**4022/6952**

Tau^2= 0.041 Q (df=2)=8.279 P value=0.053



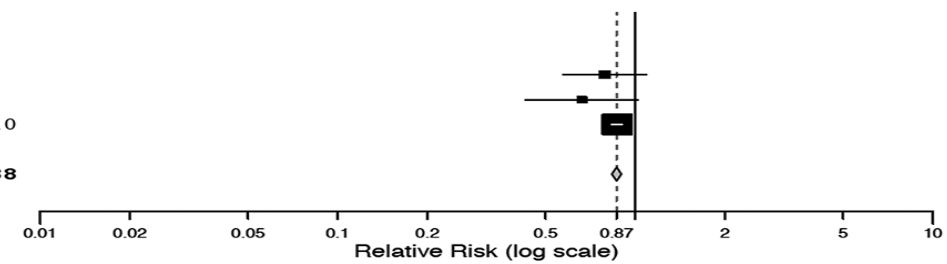
Pediatric	RR (95% CI)	Normo	Hyper
Bennett 2011	0.822 (0.604, 1.117)	30/57	41/64
De Castillo 2012	0.560 (0.406, 0.773)	43/130	36/61
Overall (I^2=65% , P=0.092)	**0.681 (0.468, 0.990)**	**73/187**	**77/125**

Tau^2= 0.047 Q (df=1)=2.840 P value=0.044



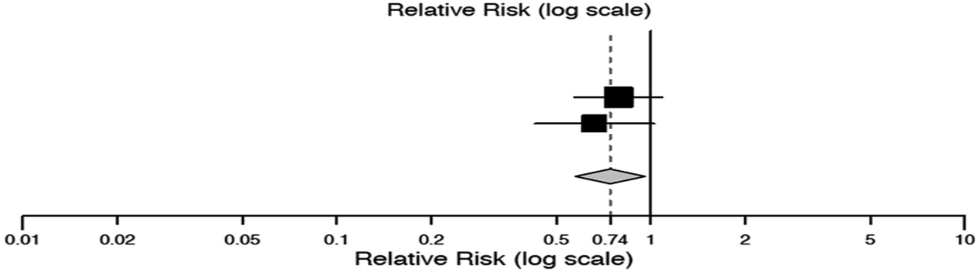
Adult+Pediatric	RR (95% CI)	Normo	Hypo
Bennett 2011	0.789 (0.575, 1.084)	30/57	32/48
De Castillo 2012	0.662 (0.429, 1.020)	43/130	15/30
Scheneider 2013	0.869 (0.837, 0.902)	3464/6705	1790/3010
Overall (I^2=0% , P=0.399)	**0.866 (0.834, 0.899)**	**3537/6892**	**1837/3088**

Tau^2= 0.000 Q (df=2)= 1.837 P value<0.001



Pediatric	Estimate (95% C.I.)	Normo	Hypo
Bennett 2011	0.789 (0.575, 1.084)	30/57	32/48
De Castillo 2012	0.662 (0.429, 1.020)	43/130	15/30
Overall (I^2=0% , P=0.519)	**0.742 (0.575, 0.959)**	**73/187**	**47/78**

Tau^2= 0.000 Q (df=1)=0.416 P value=0.519

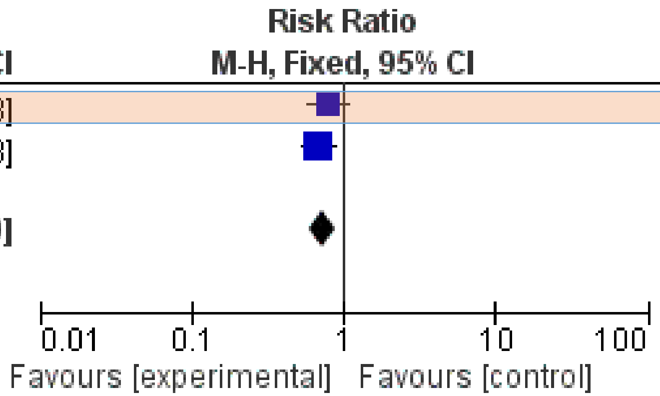


Effect of Normocapnia and Hypocapnia on Poor Neurological Outcome (Adults and Pediatrics)

Sutherasan Y et al. Minerva Anestesiol. 2015 Jan;81(1):39-51

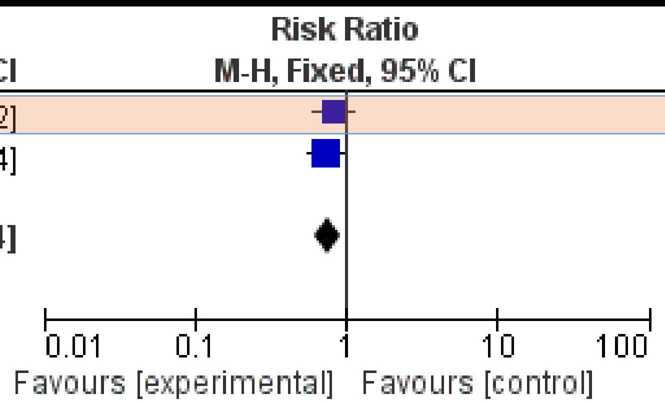
Sutherasan Y etal. Best Pract Res Clin Anaesthesiol. 2015 Dec;29(4):413-24.

	Normocapnia		Hypocapnia			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Benett 2011	30	57	32	48	43.0%	0.79 [0.57, 1.08]
Roberts 2013	34	60	43	52	57.0%	0.69 [0.53, 0.88]
Total (95% CI)		**117**		**100**	**100.0%**	**0.73 [0.60, 0.89]**
Total events	64		75			
Heterogeneity: Chi² = 0.47, df = 1 (P = 0.49); I² = 0%						
Test for overall effect: Z = 3.09 (P = 0.002)						



Effect of Normocapnia and Hypercapnia on Poor Neurological Outcome (Adults and Pediatrics)

	Normocapnia		Hypercapnia			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Benett 2011	30	57	41	64	44.7%	0.82 [0.60, 1.12]
Roberts 2013	34	60	49	63	55.3%	0.73 [0.56, 0.94]
Total (95% CI)		**117**		**127**	**100.0%**	**0.77 [0.63, 0.94]**
Total events	64		90			
Heterogeneity: Chi² = 0.35, df = 1 (P = 0.56); I² = 0%						
Test for overall effect: Z = 2.58 (P = 0.010)						



Arterial carbon dioxide tension and outcome in patients admitted to the intensive care unit after cardiac arrest

Schneider AG et al. Resuscitation 84 (2013) 927– 934

	OR (95% CI)	*p*-Value
Mortality		
Hypo- vs. normocapnia	1.12 (1.00–1.24)	0.04
Hyper- vs. normocapnia	1.06 (0.97–1.15)	0.19
Hyper- vs. hypocapnia	0.95 (0.85–1.06)	0.34
Death OR failure to be discharged home		
Hypo- vs. normocapnia	1.23 (1.10–1.37)	<0.001
Hyper- vs. normocapnia	0.97 (0.89–1.06)	0.52
Hyper- vs. hypocapnia	0.79 (0.70–0.89)	<0.001
Discharge home among survivors		
Hypo- vs. normocapnia	0.81 (.70–.94)	0.01
Hyper- vs. normocapnia	1.16 (1.03–1.32)	0.01
Hyper- vs. hypocapnia	1.43 (1.22–1.69)	<0.001

Ventilatory Management in Out-of-Hospital Cardiac Arrest

Management and Outcome of Mechanically Ventilated in Patients after Cardiac Arrest

Sutherasan Y et al. Crit Care. 2015 May 8;19:215

	All subjects N=812 Mean(SD)	Cohort 1998 N=100 Mean(SD)	Cohort 2004 N=239 Mean(SD)	Cohort 2010 N=473 Mean(SD)	P value
Tidal volume/kg	7.1(2.0)	8.86(2.0)	7.4(1.9)	6.7(1.8)	<0.001
Tidal volume /kg PBW	8.3(2.0)	No data	9.04(2.3)	7.95(1.7)	<0.001
RR/min	18.8(6.0)	16.9(4.0)	17.9(6.4)	19.4(6.0)	<0.001
Minute ventilation (L/minute)	9.6(3.1)	10.6(2.8)	9.7(3.3)	9.4(3.0)	<0.001
PIP(cmH_20)	25.5(8.0)	29.1(7.5)	27.1(7.9)	24.1(7.9)	<0.001
P Plateau(cmH_20)	20.6(6.2)	22.7(3.7)	21.5(6.5)	19.5(6.3)	<0.001
PEEP(cmH20)	5.8(3.4)	3.5(3.1)	4.8(4.0)	6.5(2.7)	<0.001
PaO_2(mmHg)	116.2(59.6)	114.3(43.7)	121.8(65)	113.9(59)	<0.001
PaO_2/FiO_2ratio	247.7(107.3)	238.4(95.1)	242.2(95.1)	252(114.1)	<0.05
$PaCO_2$(mmHg)	39.3(11.0)	37.3(7.4)	38.8(10.4)	39.8(11.7)	<0.001
pHa	7.39(0.1)	7.41(0.08)	7.39(0.1)	7.39(0.1)	<0.001

Logistic regression analysis for 28 days mortality

Sutherasan Y et al. Crit Care. 2015 May 8;19:215

Variable	Logistic regression Odd ratio(95%CI)	P value
Age,years	1.01(1.00-1.03)	0.01
PaO2 100-200 mmHg (ref)		
PaO2<100 mmHg	1.54(1.07-2.22)	0.02
PaO2>200 mmhg	1.36(0.91-2.05)	0.14
pHa 7.35-7.45(ref)		
Acidosis(pHa<7.35)	1.31(1.15-1.88)	0.14
Alkalosis(pHa>7.45)	1.15(0.69-1.92)	0.60
Cardiovascular Failure/Shock (yes/no)	1.47(1.06-2.05)	0.02
Renal Failure(yes/no)	1.31(0.90-1.91)	0.15
Use of sedative drugs	0.61(0.46-0.81)	0.001

Logistic regression analysis for ARDS and ICU Acquired Pneumonia

Sutherasan Y et al. Crit Care. 2015 May 8;19:215

Factors associated with ARDS

1) **Higher plateau pressure**
(odds ratio 1.12, 95% CI interval 1.04 to 1.21)

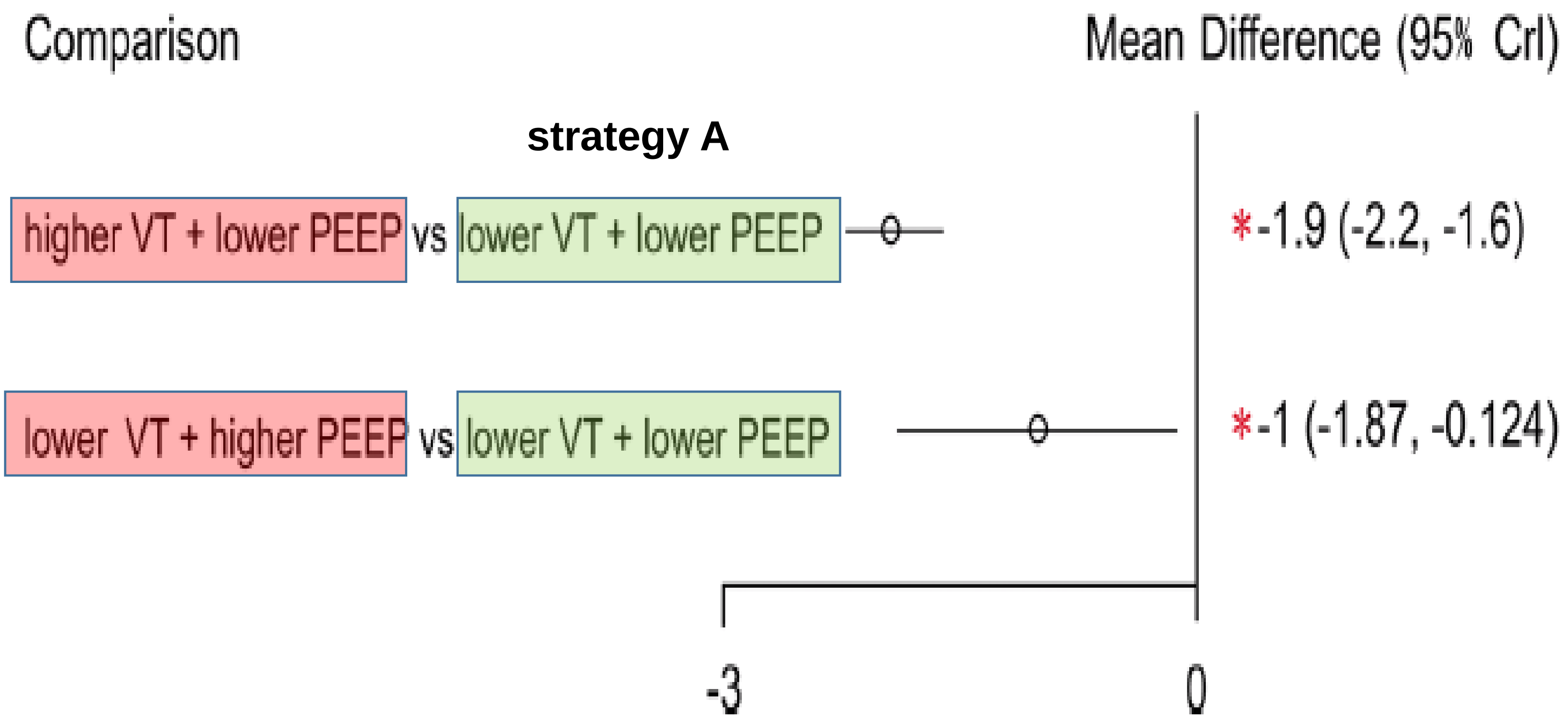
Factors associated with ICU acquired pneumonia

1) **Higher tidal volume**
(odds ratio 1.003, 95% CI 1.0003 to 1.01)

2) **Lower applied PEEP levels**
(odds ratio 0.89, 95% CI 0.80 to 0.99)

In non ARDS patients lower V_T + lower PEEP are associated with a shorter length of ICU stay

Guo L et al. Critical Care (2016) 20:226



MD <0 favors strategy A **(Low V_T/Low PEEP)**

Associations between PEEP and outcome of patients without ARDS at onset of ventilation:a systematic review and meta-analysis of randomized controlled trials

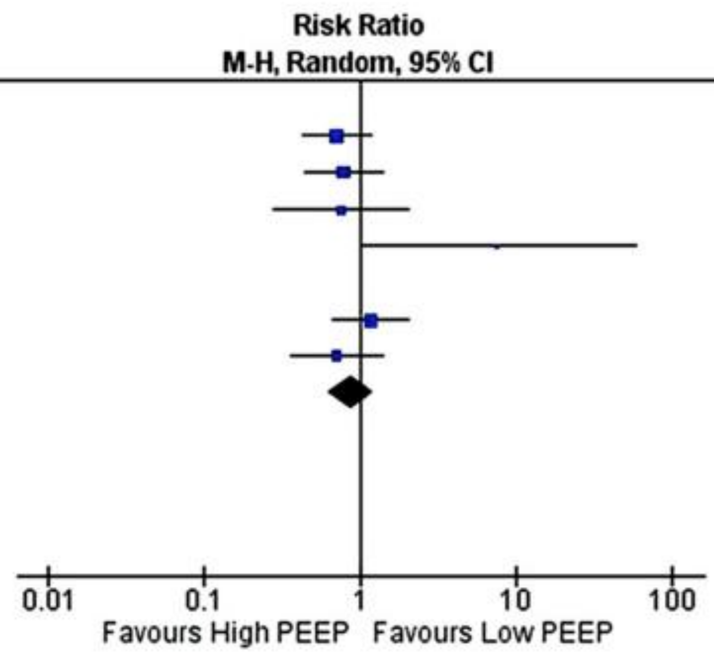
Serpa Neto et al. Ann. Intensive Care (2016) 6:109

Low PEEP = 2.0 ± 2.8 **High PEEP** = 9.7 ± 4.0

Study or Subgroup	High PEEP Events	High PEEP Total	Low PEEP Events	Low PEEP Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
1.3.2 Hospital Mortality							
Weigelt JA	16	45	17	34	25.5%	0.71 [0.42, 1.19]	1979
Pepe PE	13	44	18	48	21.8%	0.79 [0.44, 1.41]	1984
Nelson LD	5	20	6	18	9.5%	0.75 [0.28, 2.04]	1987
Carroll GC	6	22	1	28	2.6%	7.64 [0.99, 58.85]	1988
Michalopoulos A	0	21	0	22		Not estimable	1996
Manzano F	19	64	16	63	22.7%	1.17 [0.66, 2.06]	2008
Lesur O	9	30	14	33	17.8%	0.71 [0.36, 1.39]	2010
Subtotal (95% CI)		**246**		**246**	**100.0%**	**0.87 [0.62, 1.21]**	
Total events	68		72				

Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 6.74$, $df = 5$ ($P = 0.24$); $I^2 = 26\%$

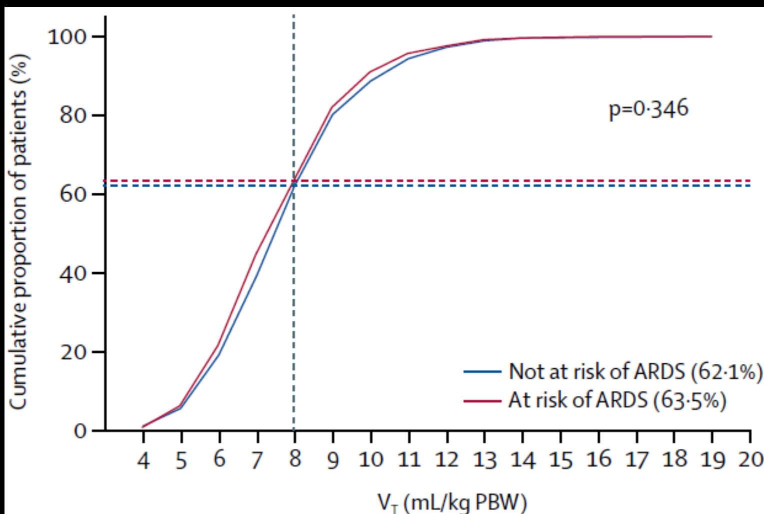
Test for overall effect: $Z = 0.82$ ($P = 0.41$)

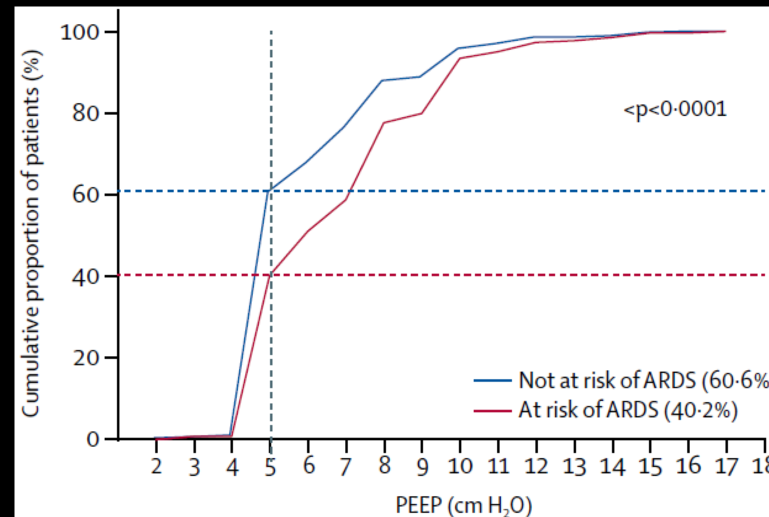


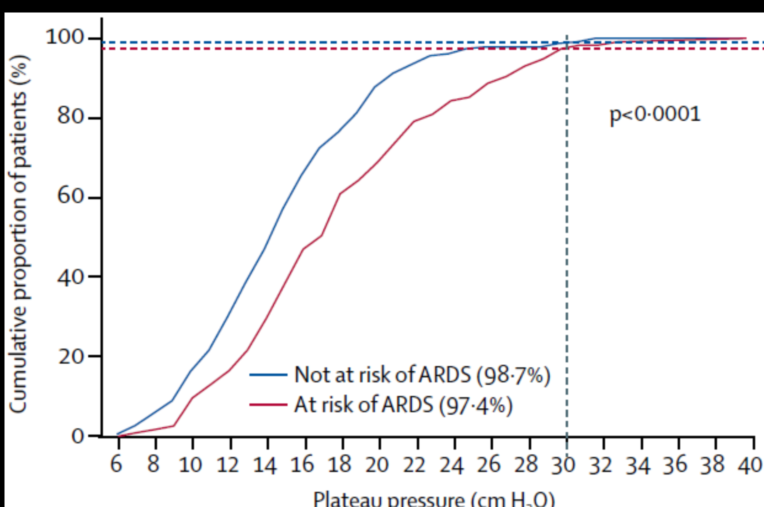
High PEEP: No effect on duration of MV – Lower rate of ARDS (high I^2)

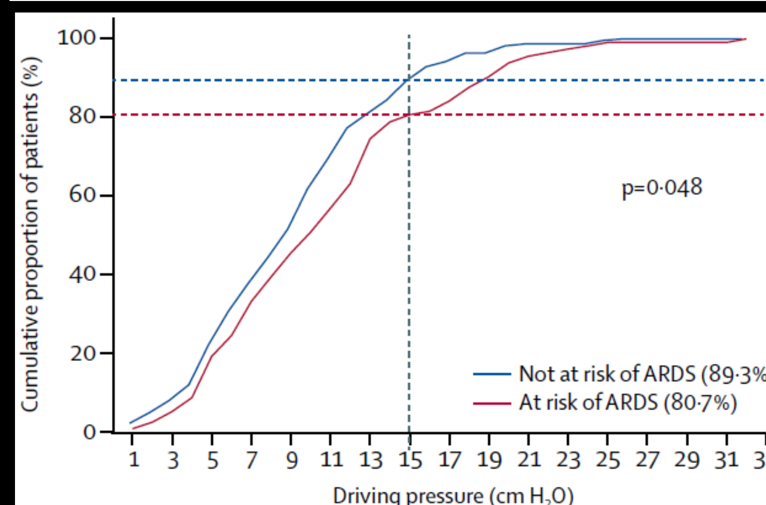
Epidemiological characteristics, practice of ventilation, and clinical outcome in pts at risk of ARDS in ICUs from 16 countries (PRoVENT): an international, multicentre, prospective study

Neto AS et al. Lancet Respir Med. 2016 Nov;4(11):882-893







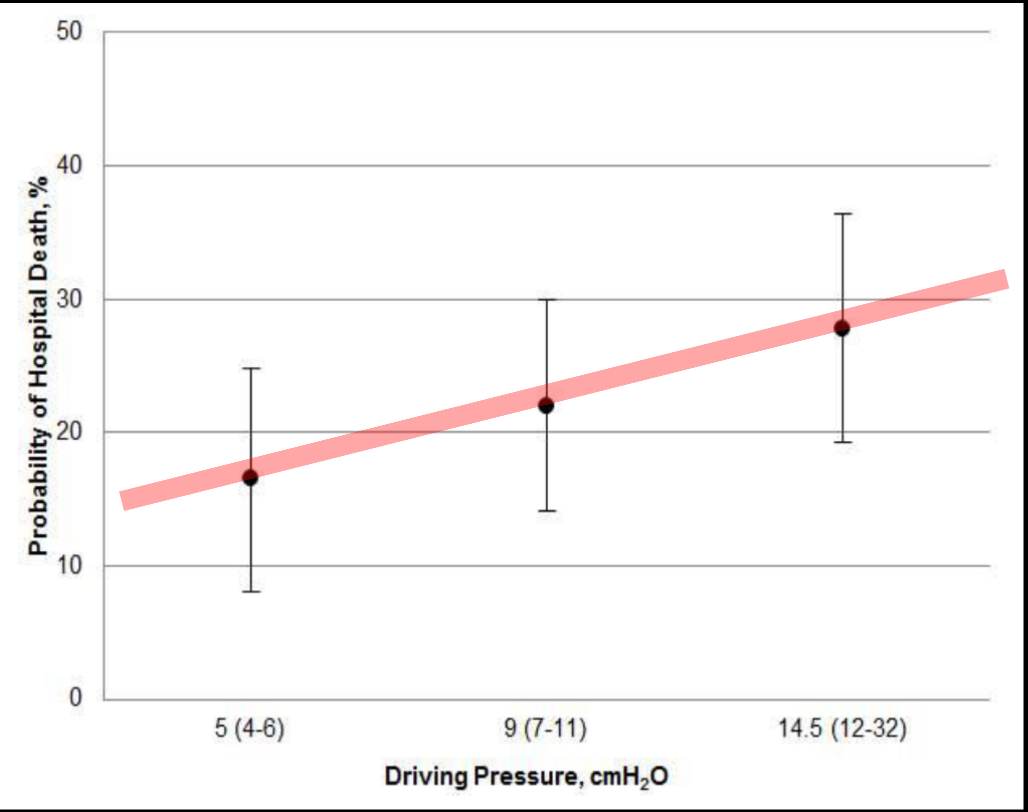


PRoVENT
Driving Pressure and Outcome in non ARDS patients

Neto AS et al. Lancet Respir Med. 2016 Nov;4(11):882-893

ΔP = Pplat,rs – PEEP = V_T/Cst = V_T/EELV

- international observational study
- 1,022 patients without ARDS



Pelosi P for the PROVE Network www.provenet.eu)

Lung Ultrasound and Transcranial Doppler in Out-of-Hospital Cardiac Arrest

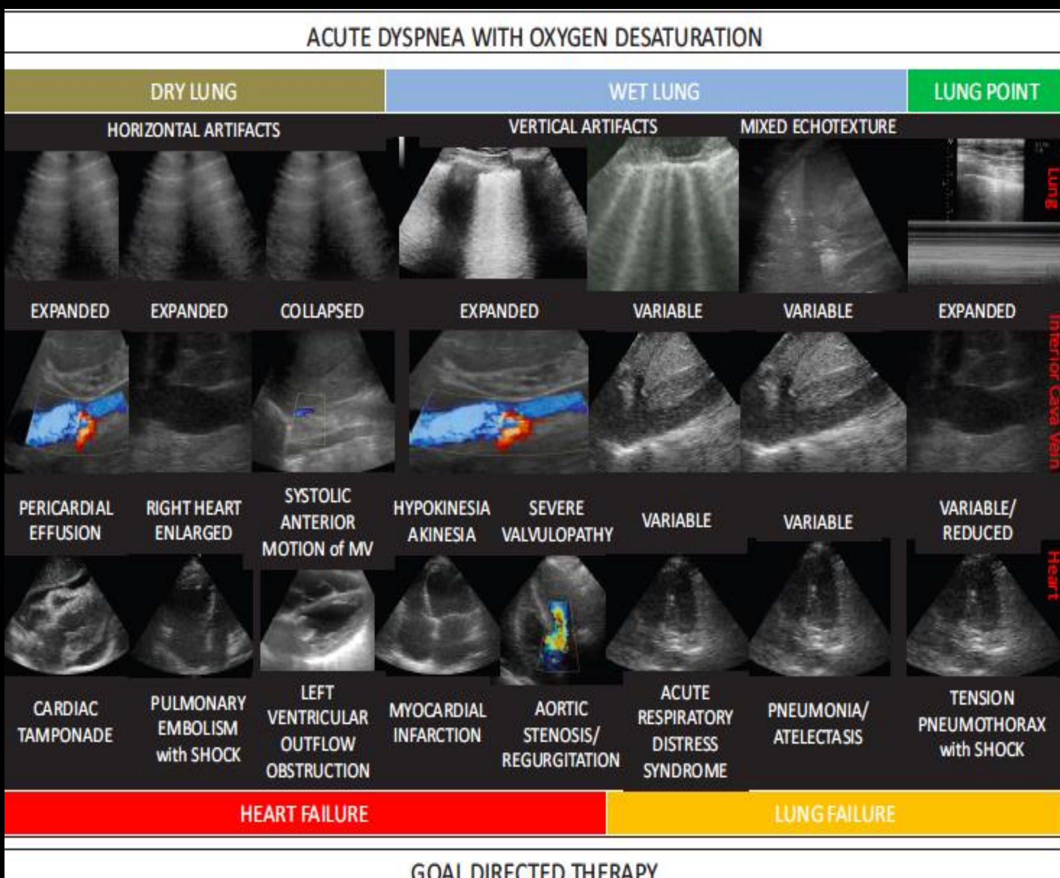
Ultrasonography in ICU: Lung, Heart, & Volemia

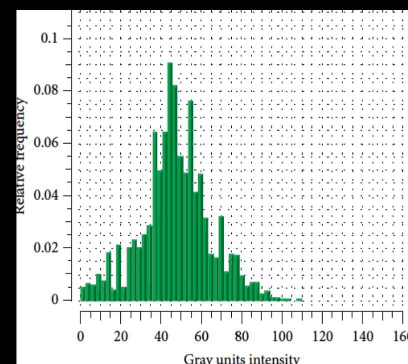
Pelosi P et al. Anesthesiology 117(4):696-698, 2012

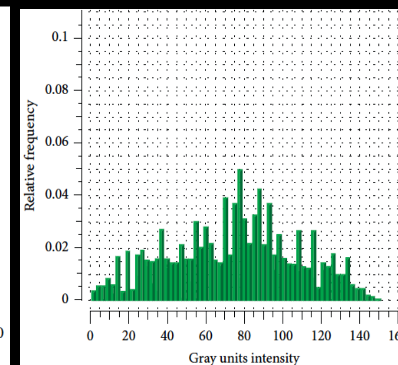
Corradi F et al. Respir Physiol & Neurobiol 187: 244-249 (2013)

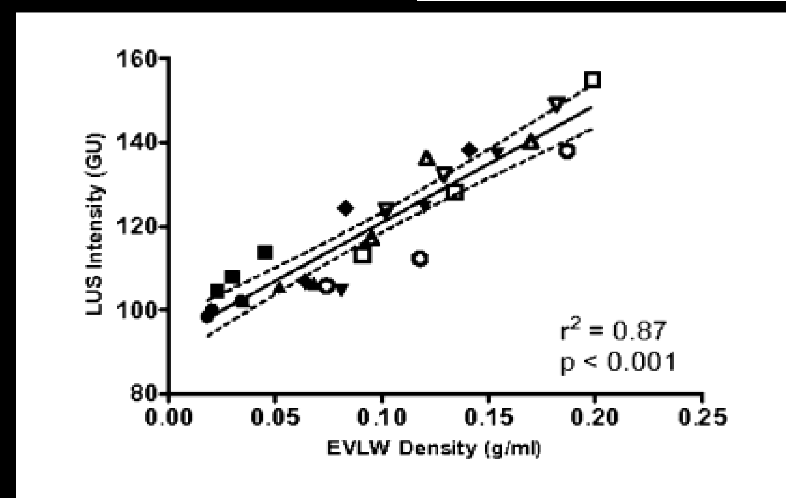
Corradi F et al. Curr Opin Crit Care. 2014 Feb;20(1):98-103

Corradi F et al. Biomed Res Int. 2015:868707 (2015)









Optic Nerve Sheat Ultrasound

Corradi F et al. ICU Management 12(2): 30-33, 2012

Pelosi P et al. Anesthesiology 117(4):696-698, 2012

Transcranial Doppler after Cardiac Arrest

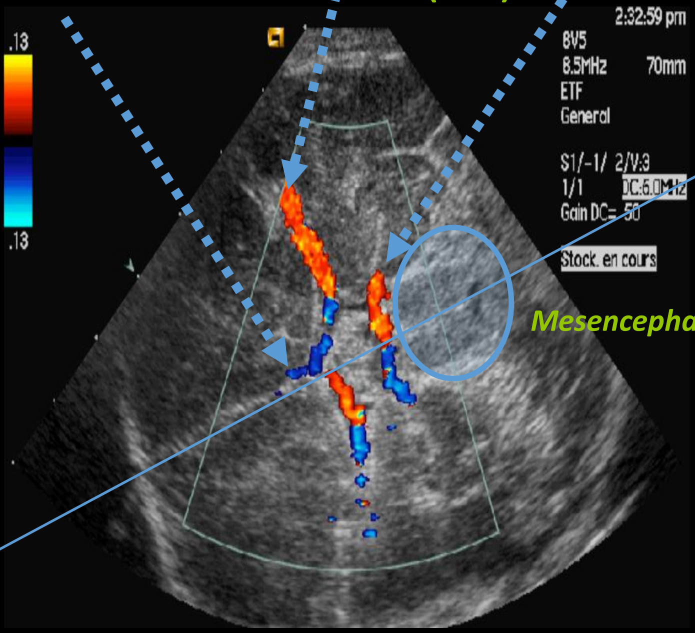
Sutherasan Y et al. Minerva Anestesiol. 2015 Jan;81(1):39-51

Sutherasan Y et al. Best Pract Res Clin Anaesthesiol. 2015 Dec;29(4):411-2

Median Cerebral Artery(MCA)

Anterior Cerebral Artery (ACA)

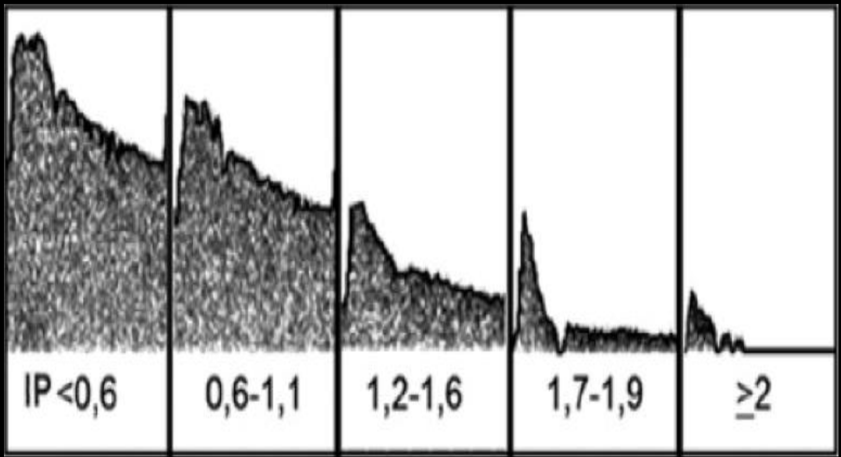
Posterior Cerebral Artery (PCA)



Mesencephalus Shadow

Median Line

Hyperemia, hypocapnia Stenosis	**Normal**	Moderate ICH, Microangio Hypocapnia	Severe ICH	Cerbral Asistolia

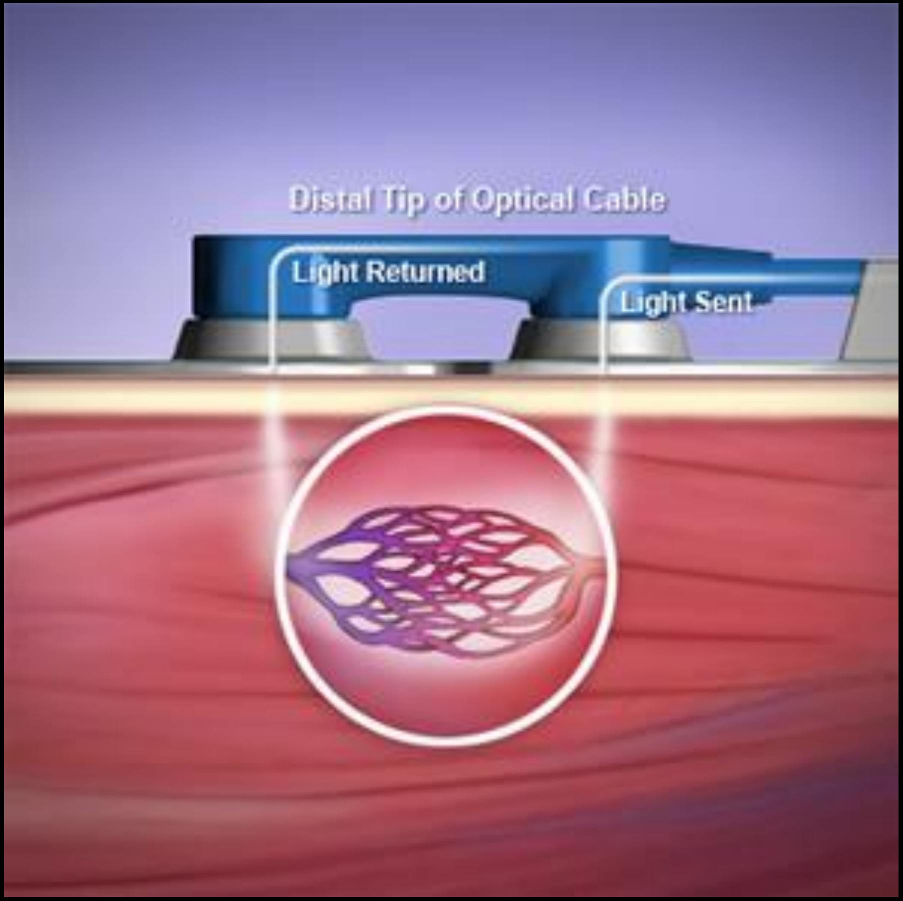


Decresed pulsatility	**Low Pulsatility** *(physiolo)*	**High Pulsatility**	**Very high Pulsatility**	**No cerebral flow**

Increase in Pulsatility Index = Increase in Distal Resistances

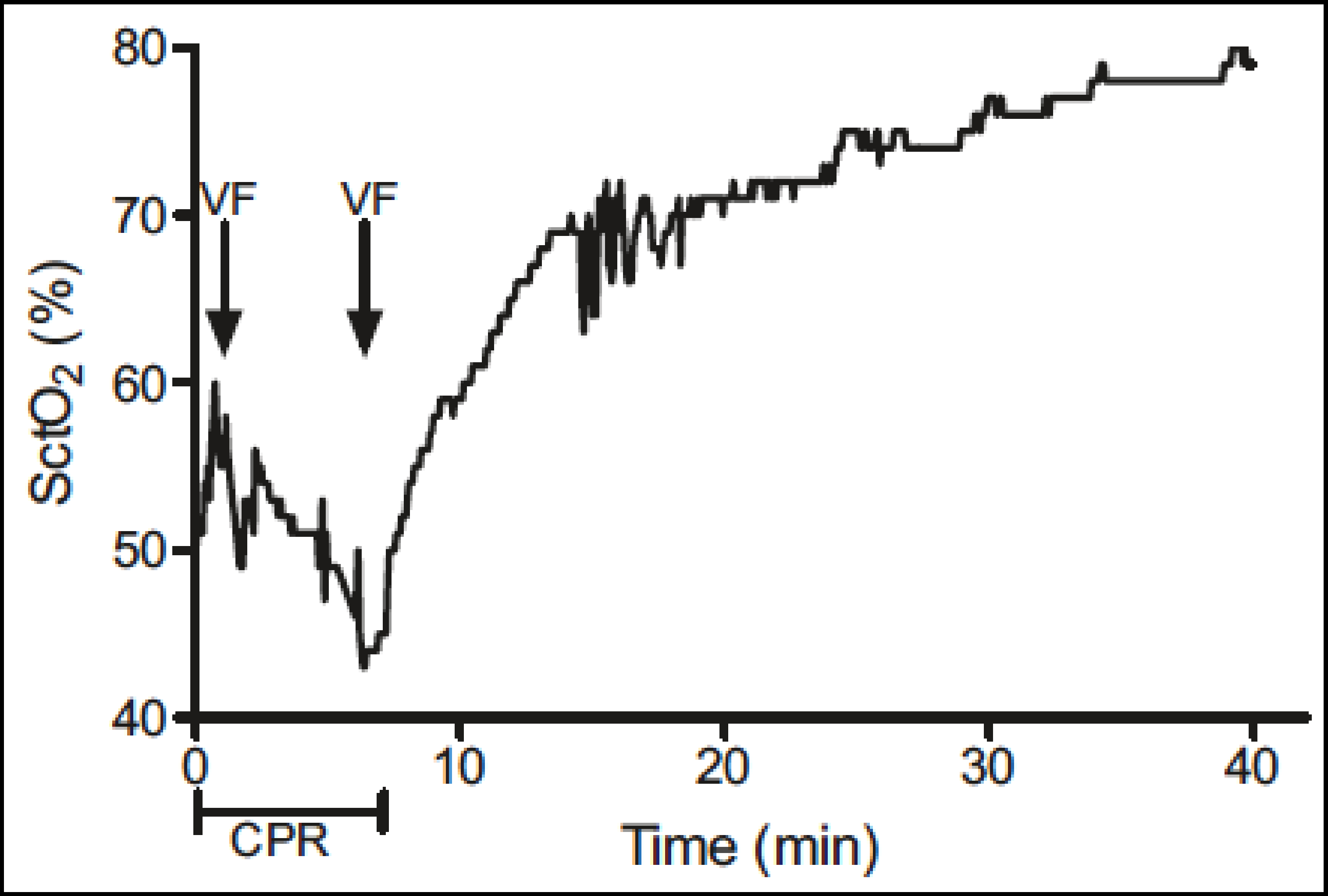
PI = (Vs - Vd) / Vm

Near-infrared spectroscopy during CPR and after Out-of-Hospital Cardiac Arrest



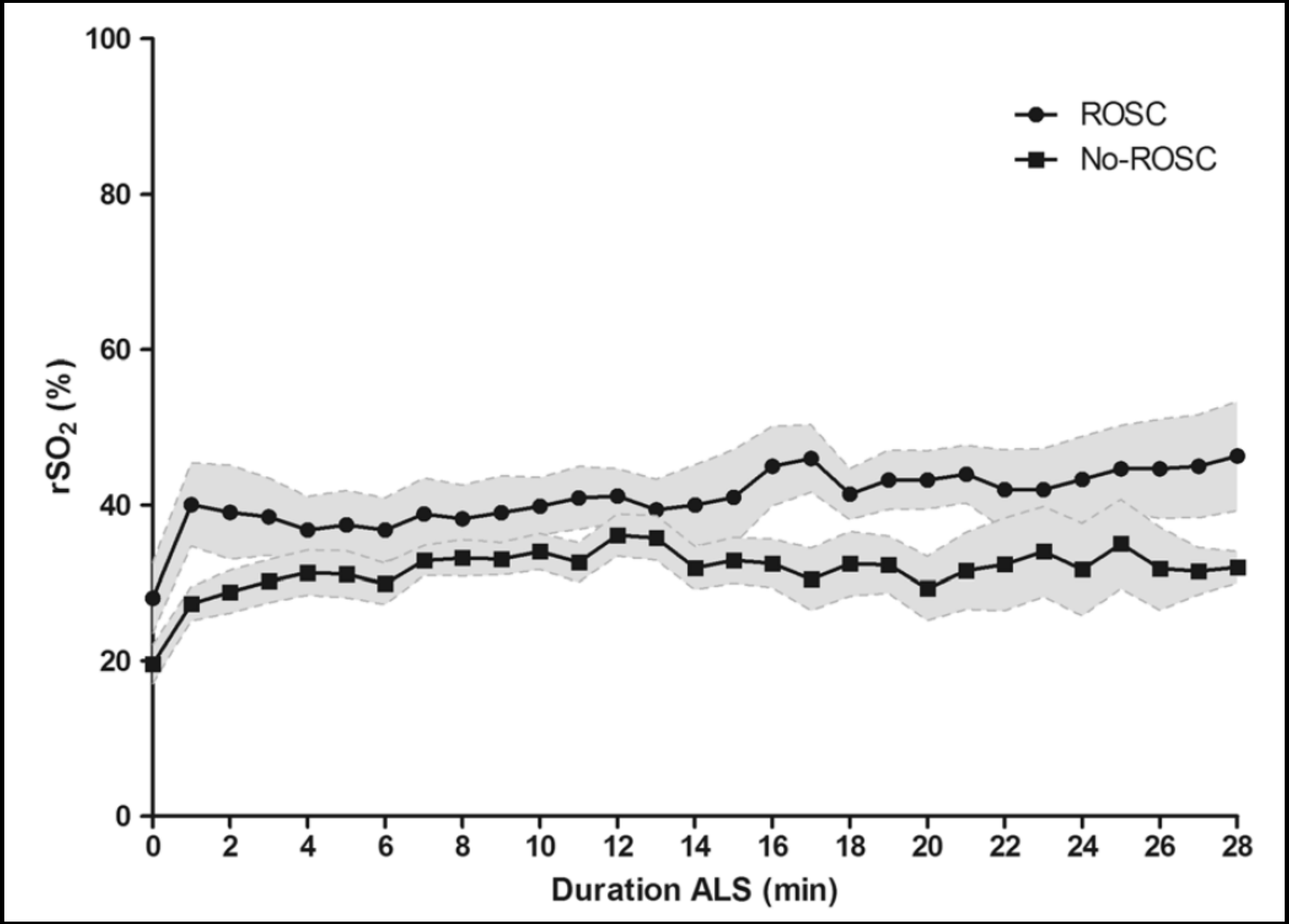
Feasibility of absolute cerebral tissue oxygen saturation during cardiopulmonary resuscitation

Meex et al. Critical Care 2013, 17:R36



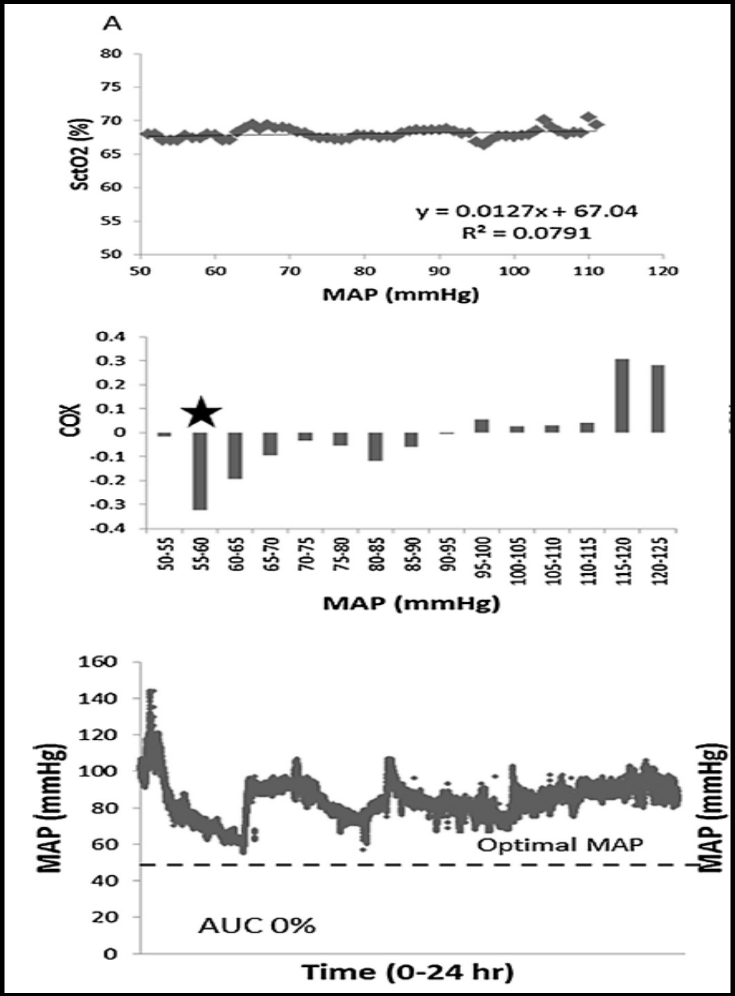
Increase in cerebral oxygenation during advanced life support in out-of-hospital patients is associated with return of spontaneous circulation

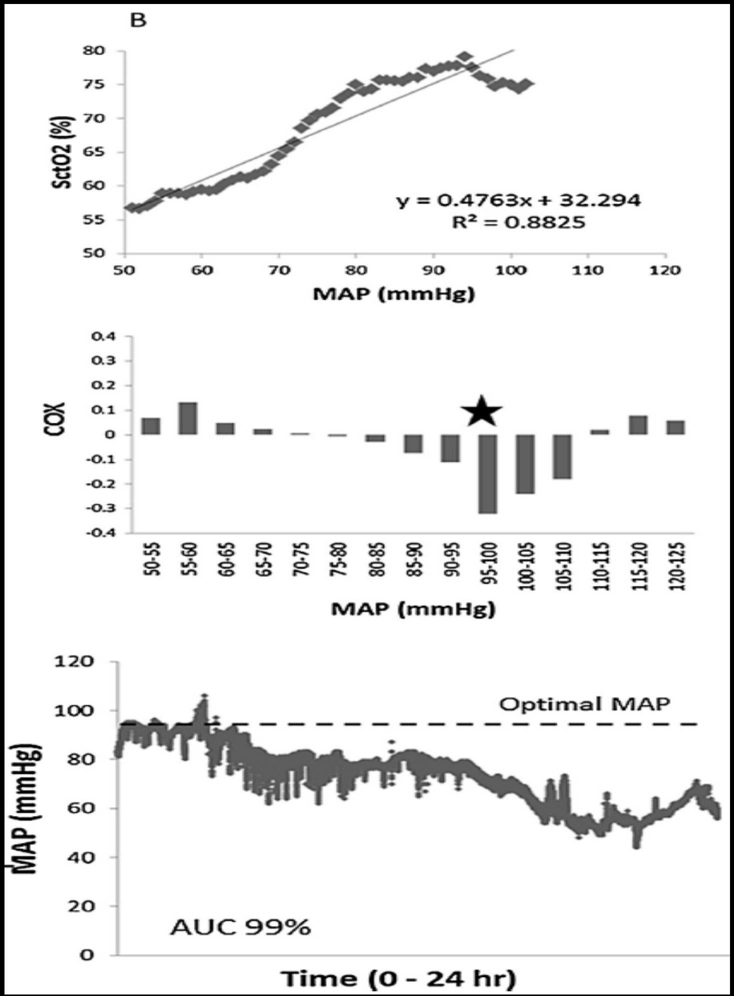
Genbrugge C et al. Critical Care (2015) 19:112



An observational near-infrared spectroscopy on cerebral autoregulation in post-cardiac arrest patients: time to drop one-size-fits-all hemodynamic targets?

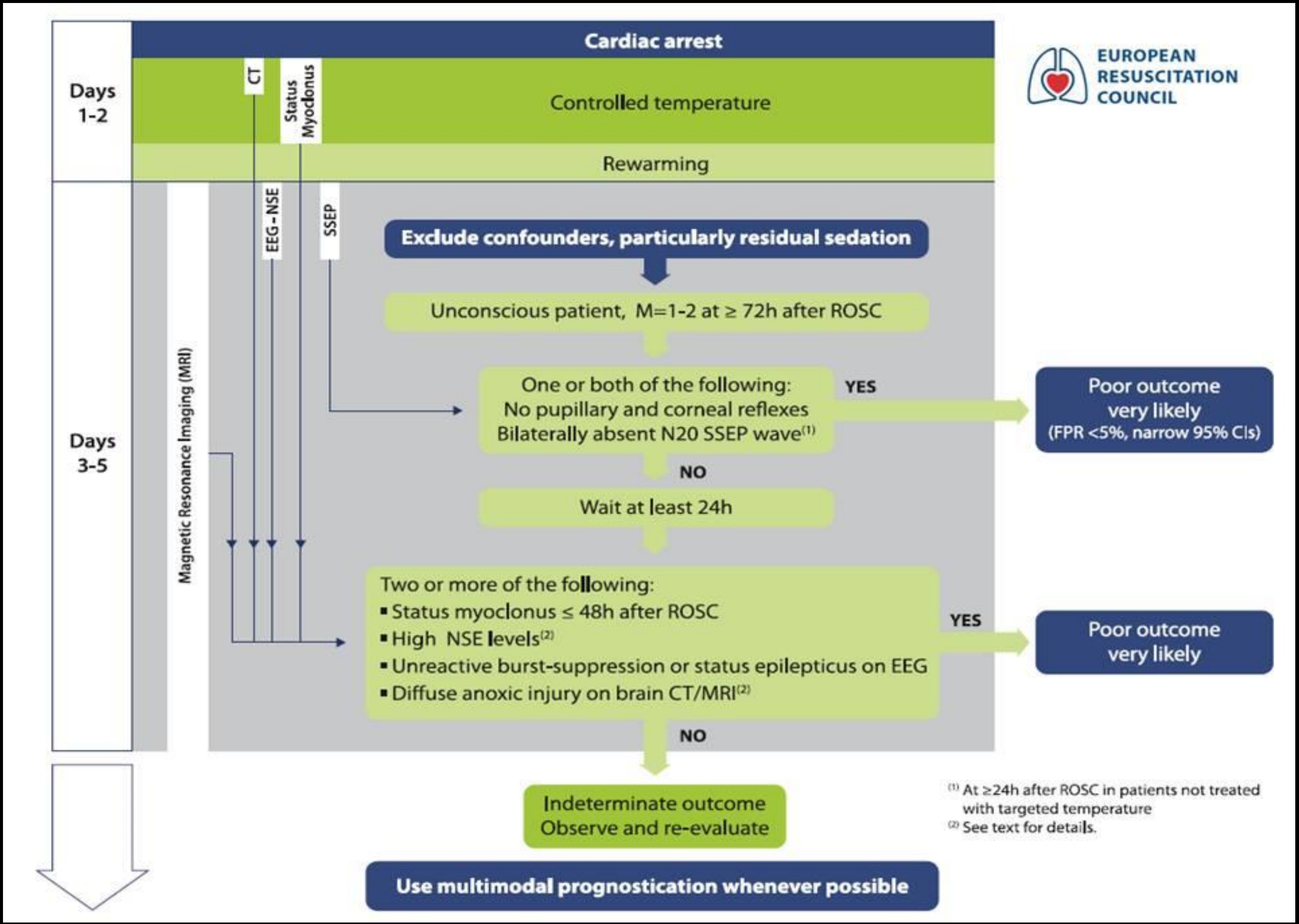
Ameloot K et al Resuscitation 90: 121-126 (2015)





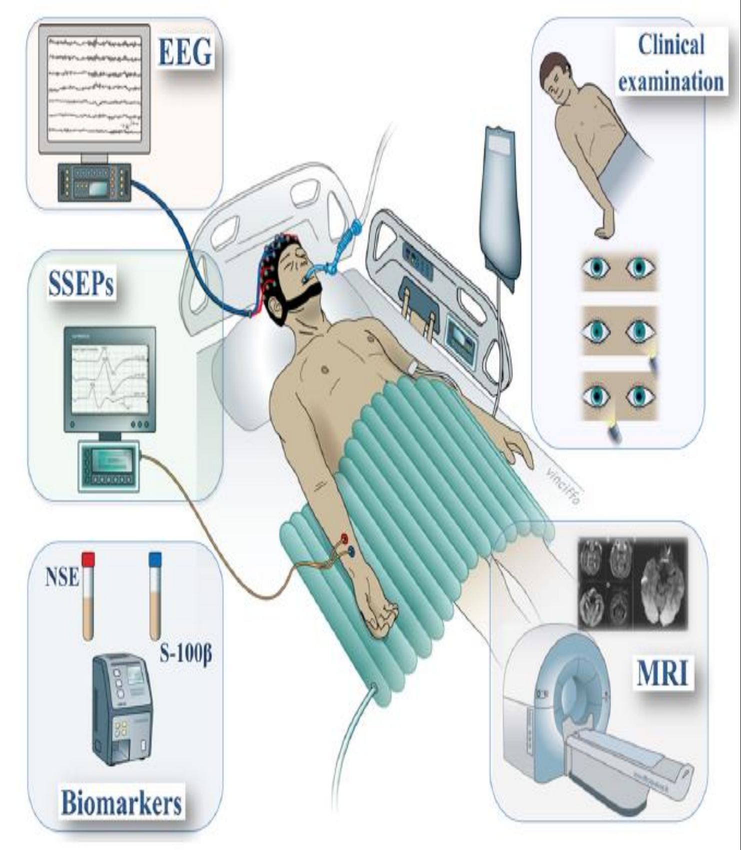
Prognosis Assessment and Quality of Life after Out-of-Hospital Cardiac Arrest

Multimodal prognostication after Cardiac Arrest



Early Multimodal Outcome Prediction After Cardiac Arrest in Patients Treated With Hypothermia

Oddo M et al. Crit Care Med. 2014 Jun;42(6):1340-7
Taccone FS et al. Critical Care 2014, 18:202



Variable	Mortality (CPC 5)	
	ROC Area	95% CI
Clinical examination[a] + EEG	0.87	0.81–0.93
Clinical examination[a] + NSE	0.83	0.76–0.89
EEG + NSE	0.87	0.81–0.93
Clinical examination[a] + EEG + NSE	0.89	0.83–0.94
Clinical examination[a] + EEG + SSEP	0.87	0.81–0.93
Clinical examination[a] + EEG + NSE + SSEP	0.88	0.83–0.94

Clinical examination, Electroencephalography Reactivity, and Serum Neuron-Specific Enolase

The TTM has contributed important findings on prognostication

Westhall E et al. Neurology 2016; Annborn M et al. Ther Hypothermia Tem Manag 2016; Stammet P et al. J Am Coll Cardiol 2015; Dragancea I et al. Resuscitation 2015; Seder DB et al. Crit Care Med 2015

- **GCS-M 1-2 is not a reliable sign of poor prognosis > 72 hours after CA**
- **Bilateral absent PLRs or CRs or bilateral absent SSEP N-20 potentials are reliable signs of poor prognosis, but false predictors occur**
- **Highly malignant EEG-patterns predict a poor prognosis with 0 FPR**
- **High NSE-levels reliably predict a poor prognosis**

Reliability of clinical tests, neurophysiological tests or biochemical markers is not affected by temperature

6 months Follow-up TTM (n=455/491)

Lilja G et al. Resuscitation 2016; Conberg T et al. JAMA Neurol 2015; Liljia G et al. Circulation 2015

Clinician-reported outcome (CPC, mRS)

- > 90% good outcome

Patient-reported outcome (TSQ, SF.36v2)

- 18% reported a new need for help in everyday activities
- 36% reported that thay had not made a complete mental recovery
- HRQoL mostly comparable to normative data

Performance outcome (MMSE)

- 31% scored below cut-off at the cognitive screening test MMSE
- 47-75% cognitive impairment within extended cognitive study

Observer-reported outcome (IQCODE)

- 62% reported a change of cognitive performance every day

Conclusions

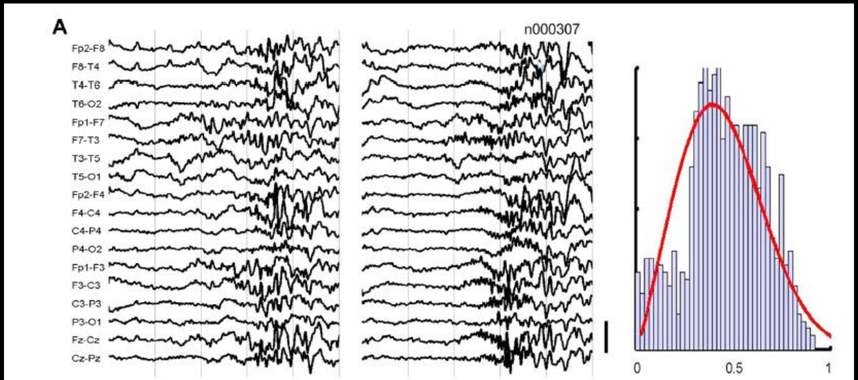
- Target Temperature Management – (32°C to 36 °C)
- Hemodynamics with MAP 65 -85 mmHg, SvO_2 65-75%
- Angiography (PCI) in STEMI or high suspicion of myocardial infarction
- Avoid hypoxia, hyperoxia & hypocapnia; moderate hypercapnia (?)
- Implement protective mechanical ventilation
- Ultrasound monitoring: optic nerve, transcranial doppler, lung
- NIRS and cerebral oxygenation
- Prognostication (clinical and multimodal) – Follow-up

Therapeutic options

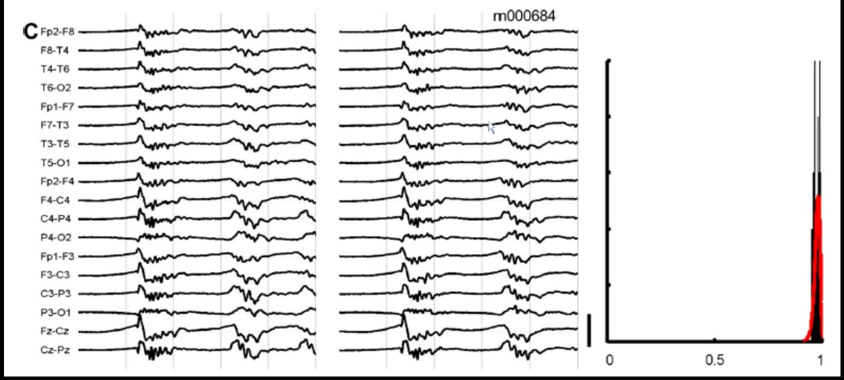
- Optimizing physiology/general intensive care treatment
  - body temperature → Therapeutic hypothermia
  - blood pressure (brain!) → Vasopressors/inotrops, fluids
  - myocardial dysfunction
  - acid-base
  - blood glucose → Glycaemic control
  - oxygenation/ventilation → Normocapnia, adequate oxygenation
  - electrolytes, especially potassium
  - anticonvulsants → Early diagnosis and treatment
- Revascularisation
  - PCI/thrombolysis on indication
  - (coronary artery bypass grafting) on indication
- Antiarrhythmic therapy
  - Revascularization
  - Beta-blockers → Hypothermia has a beta-blocker like effect
  - Amiodarone

Burst-suppression with identical bursts: a distinct EEG pattern with poor outcome in post-anoxic coma

Hofmeijer J et al. Clinical Neurophysiology 125 (2014) 947–954



“common”
burst-suppression, without identical bursts



burst-suppression with identical bursts

	Identical bursts on visual analysis		
	Yes ($n = 20$)	No ($n = 28$)	P value
Mortality	20 (100%)	10 (36%)	<0.0001
Bilateral synchrony	20 (100%)	18 (64%)	0.03
Mean amplitude (μV)	26.4 ± 16.0	6.5 ± 3.8	<0.0001
Maximal amplitude (μV)	127.8 ± 104.5	24.9 ± 14.2	0.0001
Mean inter-burst intervals (s)	53 ± 58	76 ± 339	0.8
Mean correlation coefficient of burstshape	0.85 ± 0.08	0.49 ± 0.08	<0.0001
Correlation coefficient of burstshape >0.75	19	0	<0.0001

Cognitive Function in Survivors of Out-of-Hospital Cardiac Arrest After Target Temperature Management at 33°C Versus 36°C

Gisela L et al. Circulation 2015;131:1340-1349

The Frontal Assessment Battery is a screening battery for **executive impairments**