Oxygénation Post-Arrêt Cardiaque

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APPAC ACTUALISATIONS ET PERSPECTIVES EN PATHOLOGIE CARDIOVASCULAIRE

Conseil Français de Réanimation Cardio-pulmonaire

PARIS DESCARTES FACULTÉ DE MÉDECINE

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Online article and related content current as of June 16, 2010.

Association Between Arterial Hyperoxia Following Resuscitation From Cardiac Arrest and In-Hospital Mortality

J. Hope Kilgannon; Alan E. Jones; Nathan I. Shapiro; et al.

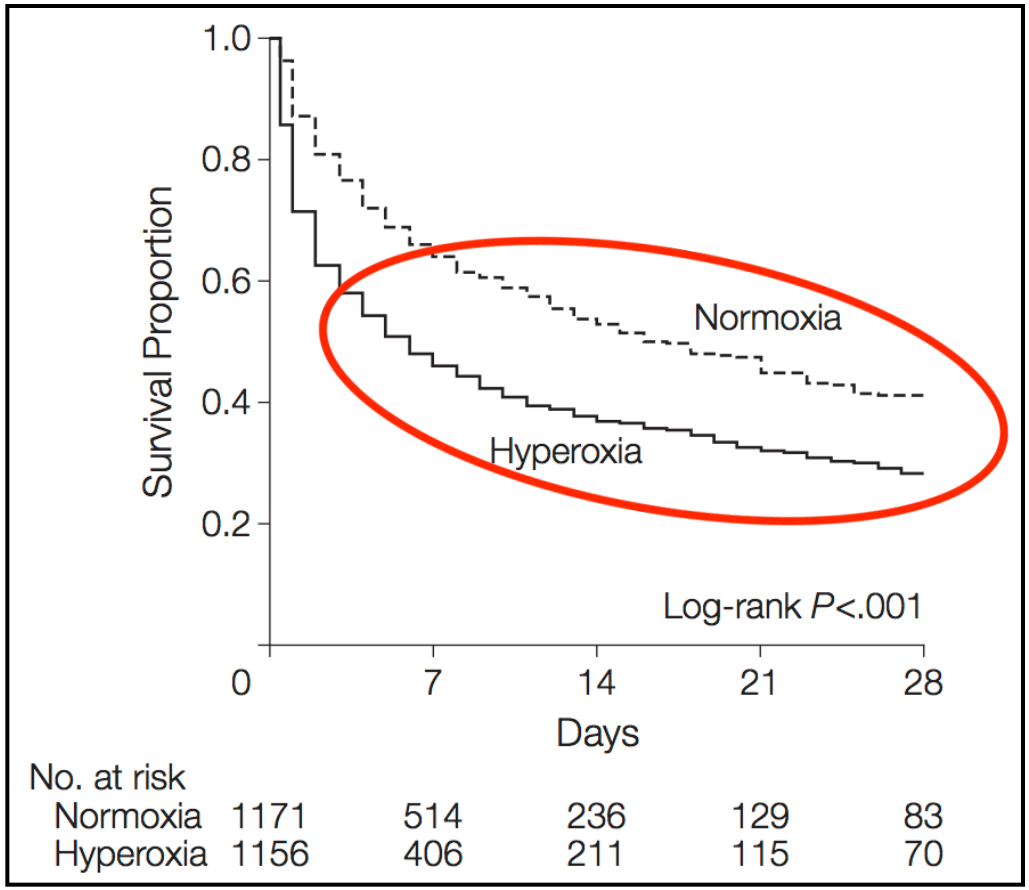
JAMA. 2010;303(21):2165-2171

- Cohorte multicentrique
  - 120 hôpitaux US
  - 6326 patients en post-AC
  - GDS < 24 1ères heures
  - 3 groupes :
    - *Hyperoxie (n=1156 ; 18%)*
    - *Normoxie (n=1171 ; 19%)*
    - *Hypoxie (n= 3999 ; 63%)*

-> Mortalité Normoxie = 45%

versus Hyperoxie = 63%

& Hypoxie = 57%



Conclusion

Part 9: Post–Cardiac Arrest Care : 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Mary Ann Peberdy, Clifton W. Callaway, Robert W. Neumar, Romergryko G. Geocadin, Janice L. Zimmerman, Michael Donnino, Andrea Gabrielli, Scott M. Silvers, Arno L. Zaritsky, Raina Merchant, Terry L. Vanden Hoek and Steven L. Kronick

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association.

Adult Immediate Post–Cardiac Arrest Care

Return of Spontaneous Circulation (ROSC)

↓

Optimize ventilation and oxygenation

- Maintain oxygen saturation ≥94%
- Consider advanced airway and waveform capnography
- Do not hyperventilate

↓

Treat hypotension (SBP <90 mm Hg)

- IV/IO bolus
- Vasopressor infusion
- Consider treatable causes
- 12-Lead ECG

↓

Doses/Details

Ventilation/Oxygenation
Avoid excessive ventilation.
Start at 10-12 breaths/min and titrate to target P_{ETCO_2} of 35-40 mm Hg.
When feasible, titrate F_{IO_2} to minimum necessary to achieve Sp_{O_2} ≥94%.

IV Bolus
1-2 L normal saline or lactated Ringer's.
If inducing hypothermia, may use 4°C fluid.

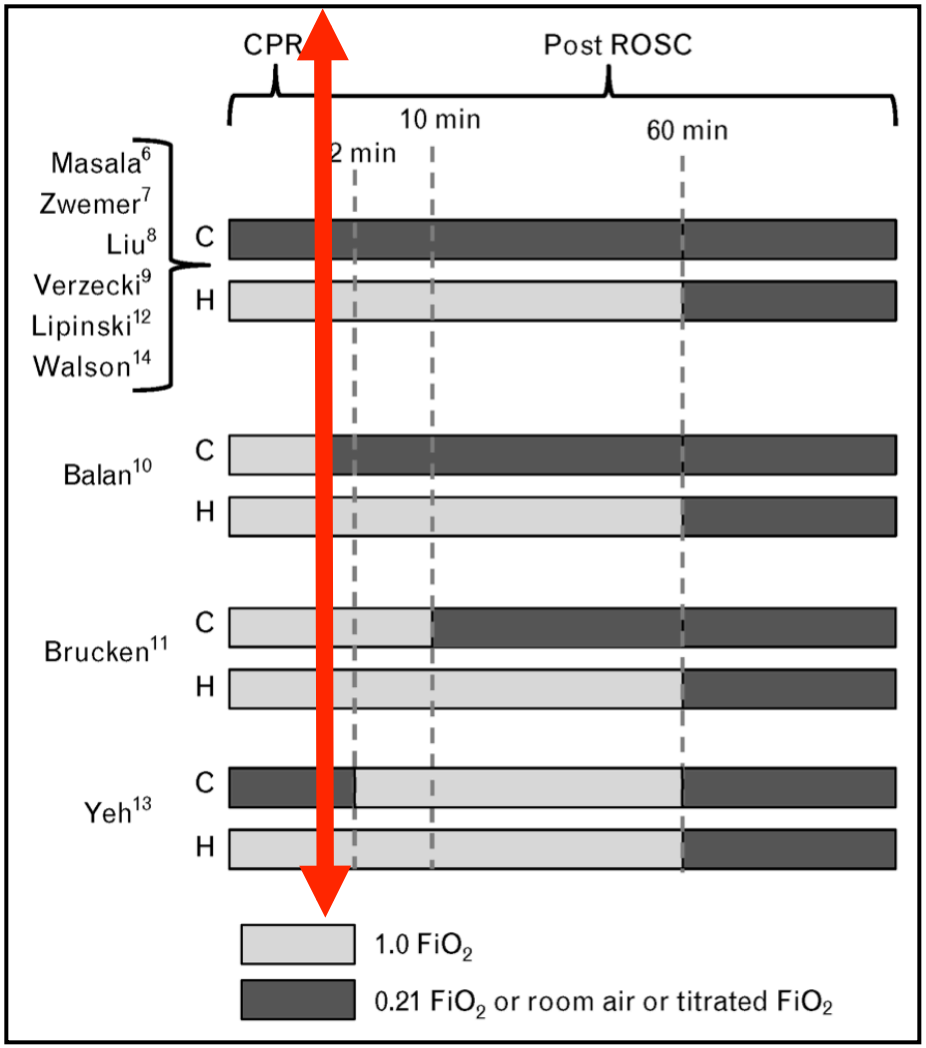
Epinephrine IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Optimal oxygenation during and after cardiopulmonary resuscitation

Robert W. Neumar

Current Opinion in Critical Care 2011, 17:236–240

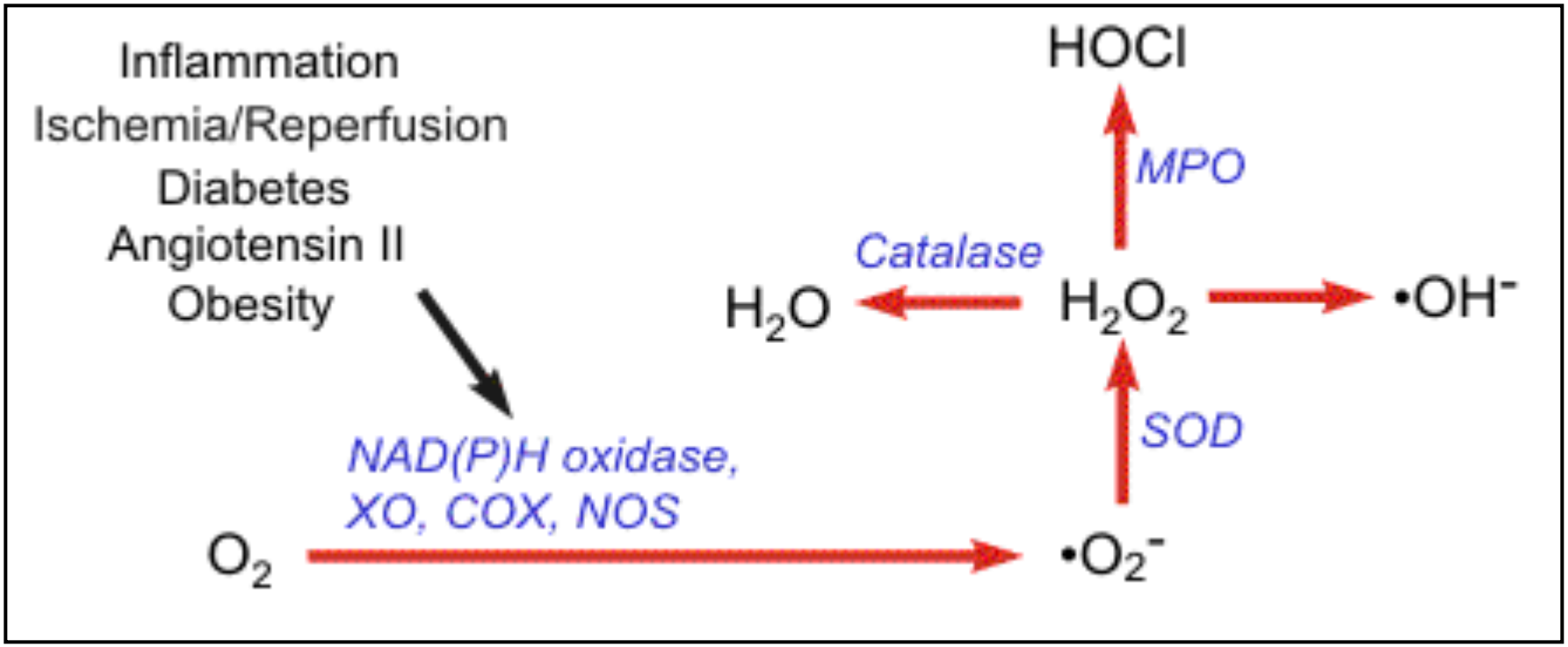
- Revue de la littérature
  - Physiopathologie
  - 9 études expérimentales
  - 3 études cliniques
    - *1 étude randomisée*
    - *2 registres rétrospectifs*
  - Recommandations
    ILCOOR 2010

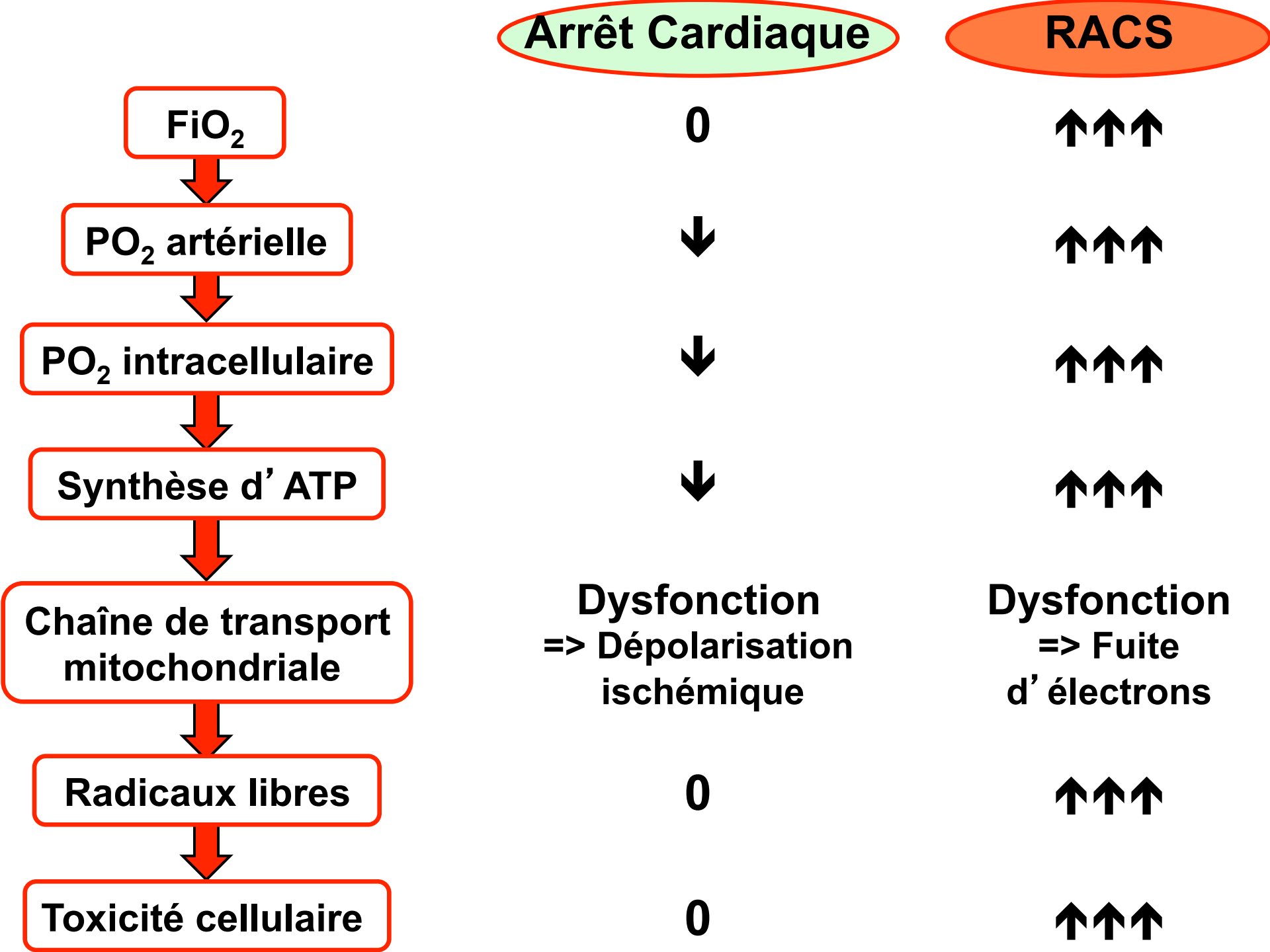


Rappel Physiopathologique

Toxicité de l'Oxygène

- Synthèse de radicaux libres lors de la phase de reperfusion
  - Ion superoxyde $O_2^{-\bullet}$




Arrêt Cardiaque
RACS
FiO2
0
PO2 artérielle
PO2 intracellulaire
Synthèse d' ATP
Chaîne de transport mitochondriale
Dysfonction
=> Dépolarisation ischémique
Dysfonction
=> Fuite d' électrons
Radicaux libres
0
Toxicité cellulaire
0

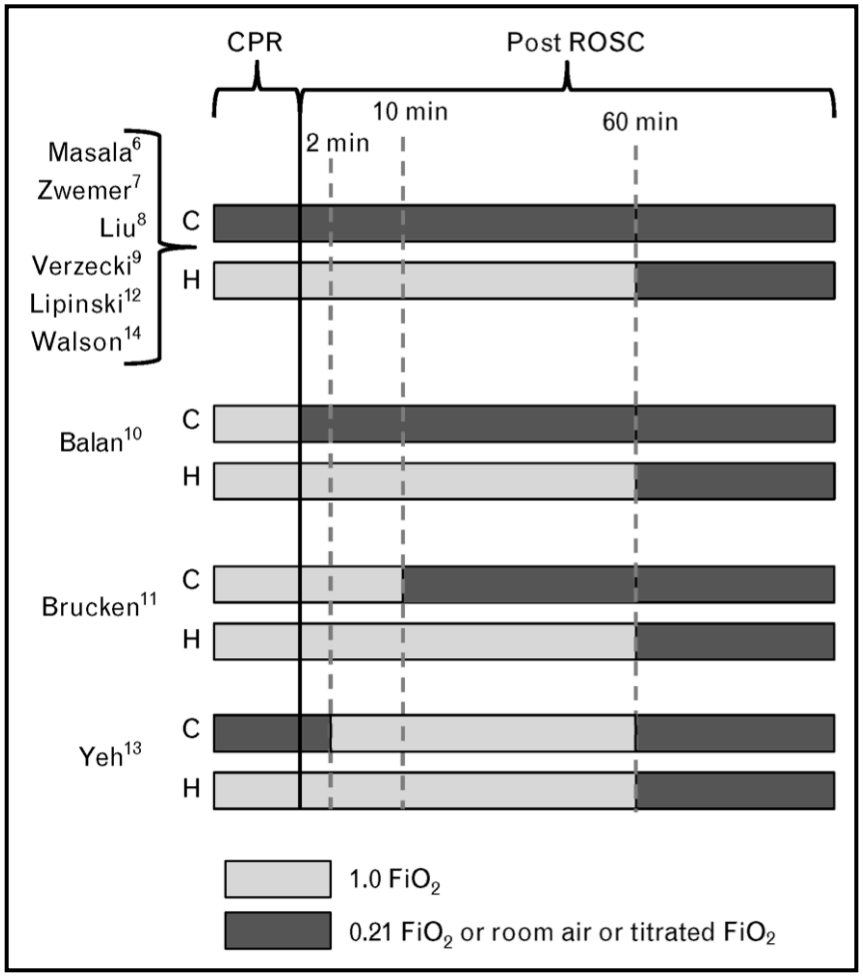
Etudes Animales

Optimal oxygenation during and after cardiopulmonary resuscitation

Robert W. Neumar

Current Opinion in Critical Care 2011, 17:236–240

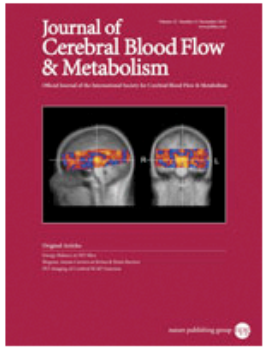
- Extrême variabilité des modèles expérimentaux
  - Animal
  - Modalités AC & RCP
  - Oxygénation
    - *pendant la RCP*
    - *après RACS*
  - Paramètres mesurés
    - *cliniques*
    - *biologiques*
    - *histologiques*



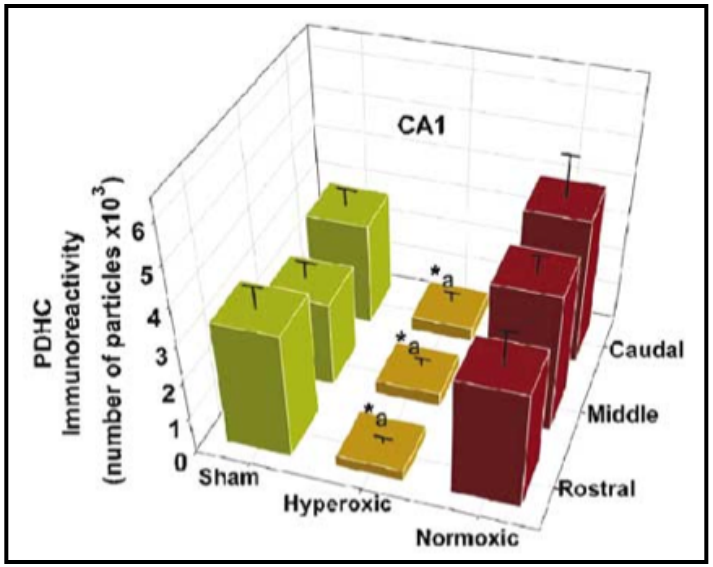
Normoxic resuscitation after cardiac arrest protects against hippocampal oxidative stress, metabolic dysfunction, and neuronal death

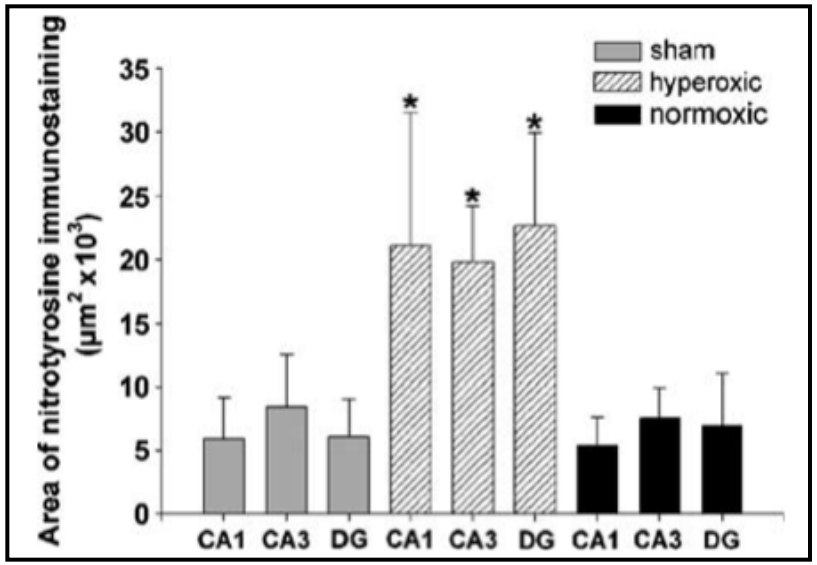
Viktoria Vereczki[1], Erica Martin[1,2], Robert E Rosenthal[1,3], Patrick R Hof[4], Gloria E Hoffman[5] and Gary Fiskum[1]

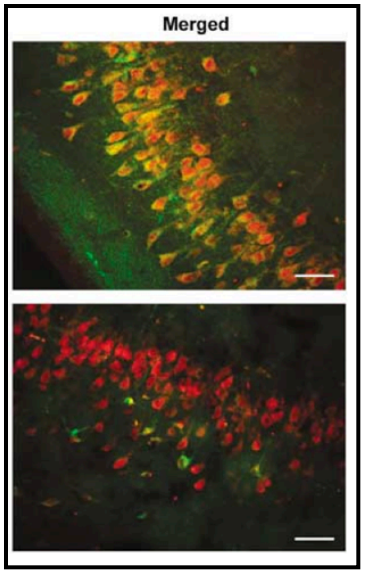
Journal of Cerebral Blood Flow & Metabolism (2006) 26, 821–835



- Modèle canin : AC 10 min en FV puis RCP
  - RCP et 1ère heure de RACS en FiO_2 21% *vs* 100%
  - Evaluation du stress oxydatif et de la mort neuronale par analyse immuno-histo-chimique cérébrale







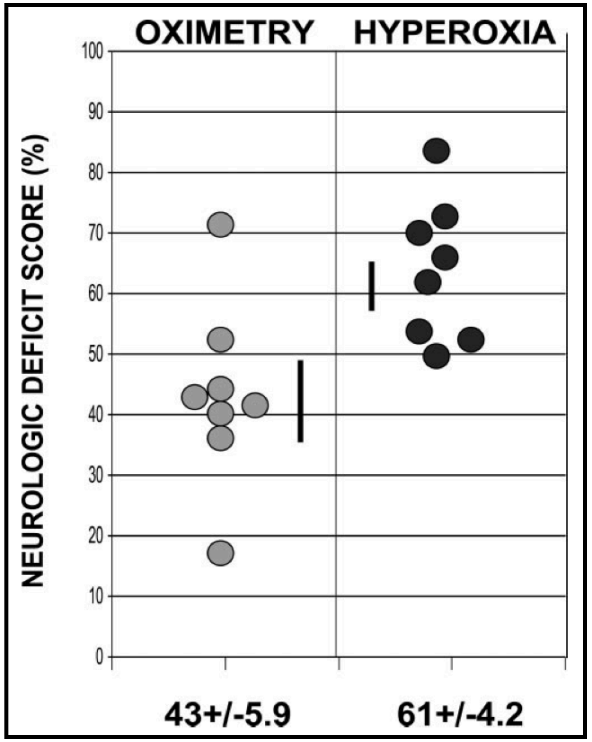
Oximetry-Guided Reoxygenation Improves Neurological Outcome After Experimental Cardiac Arrest

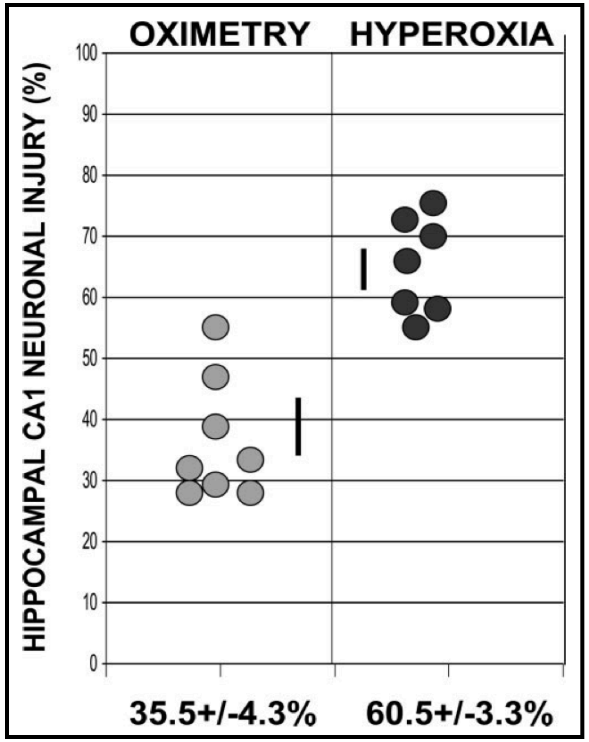
Irina S. Balan, PhD; Gary Fiskum, PhD; Julie Hazelton, MS;
Cynthia Cotto-Cumba, MD; Robert E. Rosenthal, MD

(*Stroke*. 2006;37:3008-3013.)

Stroke
Journal of the American Heart Association

- Modèle canin : AC 10 min en FV puis RCP en FiO_2 100%
  - Après RACS : FiO_2 100% *vs* FiO_2 pour SaO_2 94-96% pdt 1 h.
  - Evaluation du déficit neurologique
  - Histopathologie cérébrale





Etudes Cliniques

Hyperoxie *versus* Normoxie post-RACS

PubMed.gov
US National Library of Medicine
National Institutes of Health

Results: 25

1. Association Between Arterial **Hyperoxia** and Outcome in Subsets of Critical Illness: A Systematic Review, Metaanalysis, and Meta-Regression of Cohort Studies.
Helmerhorst HJ, Roos-Blom MJ, van Westerloo DJ, de Jonge E.
Crit Care Med. 2015 Apr 8. [Epub ahead of print]
PMID: 25855899
Similar articles

2. The association between **hyperoxia** and patient outcomes after **cardiac arrest**: analysis of a high-resolution database.
Elmer J, Scutella M, Pullalarevu R, Wang B, Vaghasia N, Trzeciak S, Rosario-Rivera BL, Guyette FX, Rittenberger JC, Dezfulian C; Pittsburgh Post-**Cardiac Arrest** Service (PCAS).
Intensive Care Med. 2015 Jan;41(1):49-57. doi: 10.1007/s00134-014-3555-6. Epub 2014 Dec 4.
PMID: 25472570
Similar articles

3. The effect of **hyperoxia** on survival following adult **cardiac arrest**: a systematic review and meta-analysis of observational studies.
Wang CH, Chang WT, Huang CH, Tsai MS, Yu PH, Wang AY, Chen NC, Chen WJ.
Resuscitation. 2014 Sep;85(9):1142-8. doi: 10.1016/j.resuscitation.2014.05.021. Epub 2014 Jun 2. Review.
PMID: 24892265
Similar articles

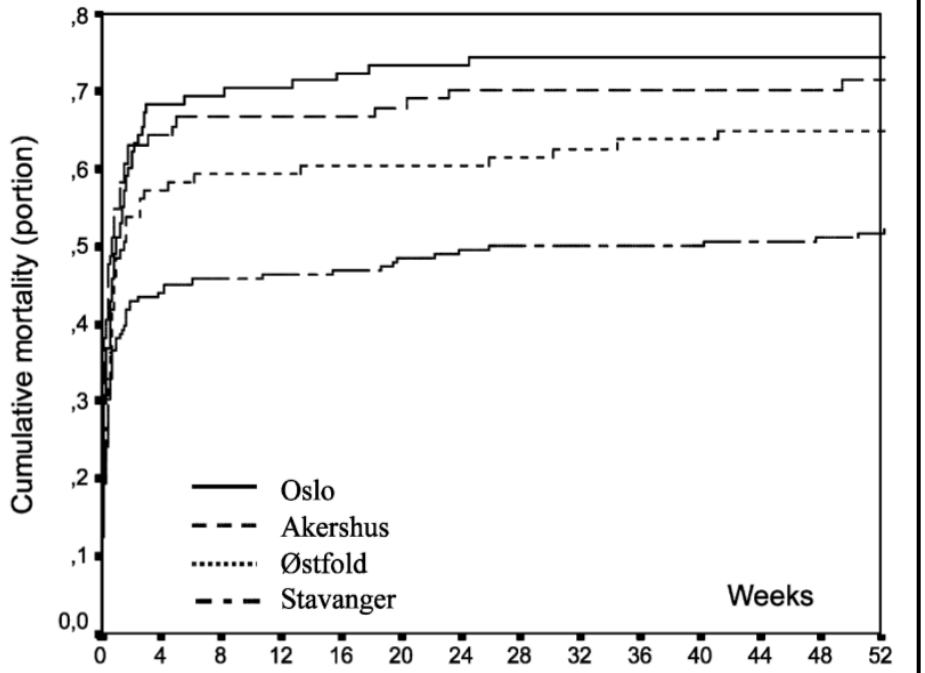
In-hospital factors associated with improved outcome after out-of-hospital cardiac arrest. A comparison between four regions in Norway

A. Langhelle [a,b,*], S.S. Tyvold [c], K. Lexow [d], S.A. Hapnes [d], K. Sunde [e], P.A. Steen [e]

Resuscitation 56 (2003) 247–263

RESUSCITATION

- Cohorte multicentrique de patients hospitalisés après ACEH
  - 4 régions distinctes de Norvège
  - Analyse des facteurs prédictifs de survie dans chaque région durant la prise en charge extra- & intra-hospitalière



Multivariate logistic-regression analysis revealing independent factors associated with survival to discharge (dependent variable) among patients admitted to hospital ($N = 166$)

	OR (95% CI)	P
Age ($\leq 71 / > 71$ years)	4.98 (1.87–13.29)	< 0.01
Overall performance category (1–3) pre-arrest	2.58 (1.24–5.35)	< 0.01
Interval: call receipt-start CPR ($\leq 1 / > 1$ min)[a]	2.47 (1.10–5.58)	< 0.05
Adrenaline (no/yes)	15.93 (5.20–48.83)	< 0.001
Seizures (no/yes)	2.72 (1.09–8.82)	< 0.05
BE $> -3.5 / \leq -3.5$ mmol l^{-1}	1.12 (1.02–1.23)	< 0.05
Temperature $\leq 37.8 / > 37.8$ °C	2.67 (1.17–6.20)	< 0.05
S-glucose $\leq 10.6 / > 10.6$ mmol l^{-1}	2.50 (1.11–5.65)	< 0.05

Estimates of odd ratio (OR) with 95% confidence interval (CI) and P-values. The cut-off values were the medians for each variable.

In-hospital factors associated with improved outcome after out-of-hospital cardiac arrest. A comparison between four regions in Norway

A. Langhelle [a,b,*], S.S. Tyvold [c], K. Lexow [d], S.A. Hapnes [d], K. Sunde [e], P.A. Steen [e]

RESUSCITATION

Resuscitation 56 (2003) 247–263

In-hospital physiological findings and monitoring the first hour after admission					
pH	7.27 (7.18–7.36)	7.27 (7.16–7.32)	7.31 (7.23–7.36)	7.30 (7.24–7.37)	< 0.05
p_{CO_2} (kPa)	4.6 (3.8–6.1)	4.9 (4.0–5.9)	5.6 (5.1–6.2)	5.0 (4.3–5.8)	
p_{O_2} (kPa)	39.6 (15.9–61.2)	26.4 (13.1–47.3)	17.4 (11.5–27.3)	17.5 (11.2–29.7)	< 0.001
BE (mmol l^{-1})	−10.6 (−15.2 to −5.5)	−10.2 (−14.6 to −5.4)	−7.0 (−13.3 to −3.0)	−6.7 (−11.7 to −3.8)	< 0.001

In-hospital physiological findings 1–12 h after admission				
pH	7.32 (7.26–7.38)	7.34 (7.26–7.40)	7.37 (7.30–7.39)	7.34 (7.29–7.39)
p_{CO_2} (kPa)	5.5 (5.0–6.2)	5.5 (4.8–6.2)	5.6 (5.1–6.2)	5.5 (4.8–6.3)
p_{O_2} (kPa)	14.9 (11.8–20.5)	13.3 (10.2–21.0)	13.8 (9.4–18.3)	13.4 (10.4–18.7)
BE (mmol l^{-1})	−4.4 (−7.2 to −2.2)	−4.4 (−7.5 to −0.3)	−1.2 (−5.6 to 0.3)	−3.1 (−5.9 to −0.2)

In- hospital physiological findings 12–24 h after admission					
pH	7.37 (7.34–7.43)	7.41 (7.35–7.46)	7.42 (7.34–7.47)	7.41 (7.37–7.44)	
p_{CO_2} (kPa)	5.2 (4.7–6.1)	5.1 (4.4–5.9)	5.1 (4.2–5.8)	5.3 (4.8–6.0)	
p_{O_2} (kPa)	12.3 (10.3–14.5)	12.3 (9.4–17.7)	11.1 (9.0–15.0)	11.8 (9.4–14.8)	
BE (mmol l^{-1})	−1.4 (−4.1 to 0.6)	−0.4 (−2.8 to 1.8)	−0.4 (−3.4 to 2.6)	0.6 (−1.9 to 2.9)	< 0.05

In-hospital course, Glasgow–Pittsburgh categories at discharge and mortality					
Glasgow–Pittsburgh categories at discharge	$n = 32$	$n = 30$	$n = 39$	$n = 103$	
Overall performance categories					< 0.001
1	39	47	23	57	
2	29	27	56	29	
3	10	20	15	14	
4	23	7	5	0	
Cerebral performance categories					< 0.01
1	59	63	64	75	
2	13	13	18	15	
3	6	17	13	11	
4	22	7	5	0	

Comparison of 30 and the 100% inspired oxygen concentrations during early post-resuscitation period: a randomised controlled pilot study☆

M. Kuisma[a,*], J. Boyd[a], V. Voipio[b], A. Alaspää[c], R.O. Roine[d], P. Rosenberg[e]

RESUSCITATION

Resuscitation (2006) **69**, 199–206

- Etude prospective randomisée monocentrique :
  - Patients hospitalisés après RACS sur ACEH par FV
  - Randomisation de la FiO_2 = 30% *versus* 100% pendant 60 min. immédiatement après RACS
  - 2 x 14 patients

- Paramètres mesurés :
  - Taux de NSE et S-100 à la 24ème et 48ème heure
  - Paramètres d'oxygénation
  - Groupe FiO_2 30% : nécessité d'↑ FiO_2 si SpO_2 < 95%

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M. Kuisma[a,*], J. Boyd[a], V. Voipio[b], A. Alaspää[c], R.O. Roine[d], P. Rosenberg[e]

RESUSCITATION

Resuscitation (2006) **69**, 199–206

Table 2 Blood gas values and the need for raising FiO_2

	Group A ($n=14$)	Group B ($n=14$)	p
Blood gases 10 min after ROSC			
PaO_2 (kPa)	21.1 ± 14.9	49.7 ± 20.8	0.0008
SaO_2 (%)	97.3 ± 3.6	99.5 ± 1.3	0.0426
$PaCO_2$ (kPa)	4.9 ± 2.4	5.6 ± 2.0	0.4042
pH	7.26 ± 0.16	7.20 ± 0.13	0.3712
BE	−11.6 ± 5.7	−12.1 ± 4.7	0.8127
Blood gases 60 min after ROSC			
PaO_2 (kPa)	14.6 ± 3.3	46.5 ± 23.2	<0.0001
SaO_2 (%)	98.3 ± 1.2	99.5 ± 1.2	0.0338
$PaCO_2$ (kPa)	5.4 ± 1.4	5.4 ± 1.0	0.9163
pH	7.32 ± 0.13	7.32 ± 0.10	0.8751
BE	−4.8 ± 5.0	−5.1 ± 3.9	0.8558
Need to raise FiO_2			
Yes	5		
No	9		
Final inspiratory oxygen (%)			
After FiO_2 raise	32.9 ± 6.1	100 ± 0	–

Group A was ventilated with 30% oxygen and group B with 100% oxygen. ROSC: return of spontaneous circulation.

1 kPpa = 7,5 mmHg

Comparison of 30 and the 100% inspired oxygen concentrations during early post-resuscitation period: a randomised controlled pilot study☆

M. Kuisma[a,*], J. Boyd[a], V. Voipio[b], A. Alaspää[c], R.O. Roine[d], P. Rosenberg[e]

RESUSCITATION

Resuscitation (2006) **69**, 199—206

Table 3 Biomarkers of neuronal injury

	Group A ($n=14$)	Group B ($n=14$)	p
All patients ($n=28$)			
NSE (μg/l)			
30 min after ROSC	10.5 ± 3.3	9.8 ± 2.3	0.6652
24 h after ROSC	10.9 ± 7.7	13.0 ± 7.3	0.1985
48 h after ROSC	14.2 ± 19.4	18.6 ± 21.0	0.5913
S-100 (μg/l)			
30 min after ROSC	0.79 ± 0.45	1.33 ± 1.31	0.6256
24 h after ROSC	0.21 ± 0.15	0.47 ± 0.79	0.2766
48 h after ROSC	0.23 ± 0.21	0.39 ± 0.43	0.3600
	Group A ($n=8$)	**Group B ($n=7$)**	**p**
Patients who were not treated with therapeutic hypothermia in hospital ($n=15$)			
NSE (μg/l)			
30 min after ROSC	10.1 ± 4.0	10.8 ± 2.6	0.8815
24 h after ROSC	7.6 ± 4.2	13.5 ± 9.6	0.0487
48 h after ROSC	7.4 ± 2.9	21.4 ± 25.8	0.4233
S-100 (μg/l)			
30 min after ROSC	0.77 ± 0.51	2.08 ± 1.55	0.1213
24 h after ROSC	0.17 ± 0.05	0.73 ± 1.1	0.2012
48 h after ROSC	0.15 ± 0.08	0.49 ± 0.61	0.3913

Group A was ventilated with 30% oxygen and group B with 100% oxygen.

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JAMA. 2010;303(21):2165-2171

- Cohorte prospective (IMPACT)
  - 131 réanimations polyvalentes
  - 400 000 patients, 2001-2005
- Patients en RACS post-AC
  - 3 questions :
    - *Fréquence de l'hyperoxie en post-AC (PaO_2 ≥ 300 mHg) ?*
    - *Corrélation avec la survie à la sortie de l'hôpital ?*
    - *Corrélation avec la mortalité intra-hospitalière en analyse multivariée ?*

Table 1. Baseline Characteristics of the Study Patients[a]

Patient Characteristics	No. (%) of Patients[b] All Patients (N = 6326)	Hypoxia (n = 3999)	Normoxia (n = 1171)	Hyperoxia (n = 1156)
Age, mean (SD), y	64 (17)	64 (16)	63 (17)	66 (16)
Female sex	2911 (46)	1766 (44)	573 (49)	572 (50)
Race/ethnicity				
White	4757 (75)	3049 (76)	850 (73)	858 (74)
Black	1041 (17)	621 (16)	223 (19)	197 (17)
Latino/Hispanic	245 (4)	153 (4)	39 (3)	53 (5)
Asian/Pacific Islander	55 (1)	33 (1)	15 (1)	7 (1)
Other[c]	228 (4)	143 (4)	44 (4)	41 (4)
Preadmission functional status[d]				
Independent	4146 (66)	2607 (65)	787 (67)	752 (65)
Partially dependent	1377 (22)	862 (22)	243 (21)	272 (24)
Fully dependent	803 (13)	530 (13)	141 (12)	132 (11)
Chronic comorbidities				
Severe cardiovascular disease[e]	732 (12)	463 (12)	124 (11)	145 (13)
Respiratory disease[f]	693 (11)	459 (11)	113 (10)	121 (11)
End-stage renal disease	545 (9)	306 (8)	106 (9)	133 (12)
Hepatic cirrhosis with portal hypertension	154 (2)	104 (3)	25 (2)	25 (2)
Cancer with metastatic disease	271 (4)	180 (5)	40 (3)	51 (4)
Active chemotherapy	127 (2)	12 (<1)	9 (1)	26 (2)
AIDS	37 (1)	19 (<1)	9 (1)	9 (1)
Hematologic malignancy	29 (<1)	24 (<1)	4 (<1)	1 (<1)
ACC at ICU admission that may be associated with oxygen status				
Acute respiratory failure	599 (9)	415 (10)	111 (9)	73 (6)
Decompensated congestive heart failure	64 (1)	54 (1)	6 (<1)	4 (<1)
Pulmonary embolism	26 (<1)	18 (<1)	5 (<1)	3 (<1)
Exacerbation of asthma or COPD	91 (1)	63 (2)	19 (2)	9 (1)
Pneumonia	112 (2)	80 (2)	17 (1)	15 (1)
Noncardiogenic pulmonary edema	18 (<1)	13 (<1)	3 (<1)	2 (<1)
Location prior to ICU arrival				
Emergency department	2747 (43)	1648 (41)	675 (58)	424 (37)
Hospital inpatient	3579 (57)	2351 (59)	496 (42)	732 (63)

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J. Hope Kilgannon; Alan E. Jones; Nathan I. Shapiro; et al.

JAMA. 2010;303(21):2165-2171

- 6326 patients avec RACS après ACEH non-traumatique
  - Classification / plus mauvais GDS des 24 premières heures

Hyperoxie : $PaO_2 \geq 300$ mmHg / Hypoxie : $PaO_2 < 60$ mmHg

Table 3. Abnormal Vital Signs in the First 24 Hours in the Intensive Care Unit and Interventions

	All Patients (N = 6326)	Hypoxia (n = 3999)	Normoxia (n = 1171)	Hyperoxia (n = 1156)
	Mean (SD)			
High temperature, °C	38 (3)	38 (3)	38 (1)	38 (3)
Low temperature, °C	36 (3)	36 (1)	36 (1)	36 (3)
High heart rate, beats/min	117 (25)	119 (25)	114 (24)	117 (26)
High respiratory rate, breaths/min	26 (9)	24 (8)	24 (8)	25 (6)
Low systolic blood pressure, mm Hg	85 (22)	83 (22)	91 (21)	83 (23)
Low mean arterial pressure, mm Hg	60 (16)	58 (16)	65 (15)	58 (16)
	No. (%)			
Hemodynamic support				
Vasopressor agent[a]	3789 (60)	2574 (64)	513 (44)	702 (61)
Dobutamine	591 (9)	412 (10)	83 (7)	96 (8)
Ventilator support[b]	6123 (97)	3842 (96)	1150 (98)	1131 (98)

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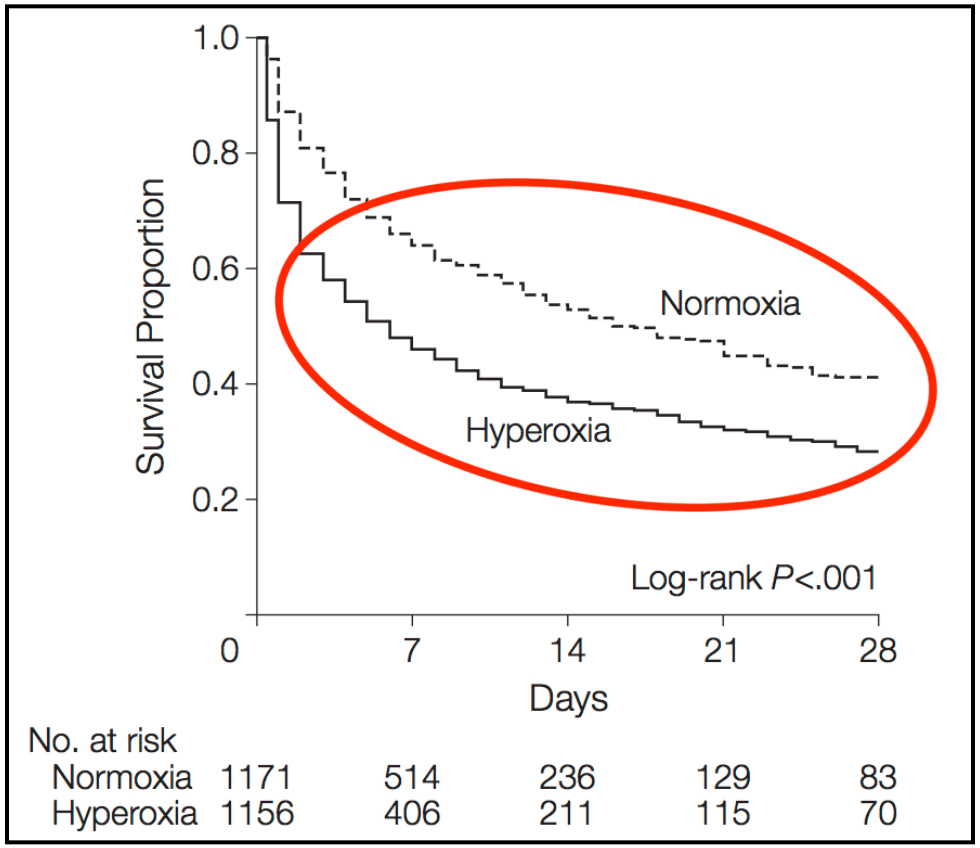
- Groupe Hyperoxie :
  - ↑ mortalité intra-hospitalière & ↓ taux sortie vivant de l'hôpital



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Association Between Arterial Hyperoxia Following Resuscitation From Cardiac Arrest and In-Hospital Mortality

J. Hope Kilgannon; Alan E. Jones; Nathan I. Shapiro; et al.

JAMA. 2010;303(21):2165-2171

P < 0,001

Table 4. Outcomes of Study Patients

	All Patients (N = 6326)	Hypoxia (n = 3999)	Normoxia (n = 1171)	Hyperoxia (n = 1156)
In-hospital mortality, No. (%) [95% CI][a]	3561 (56) [55-58]	2297 (57) [56-59]	532 (45) [43-48]	732 (63) [60-66]
Survivors, No. (%)	2765 (44)	1702 (43)	639 (55)	424 (37)
Independent functional status at hospital discharge, No. (%) [95% CI][b]	939 (34) [32-36]	570 (33) [31-36]	245 (38) [35-42]	124 (29) [25-34]
Discharge destination, No. (%)				
Home	1203 (44)	746 (44)	294 (46)	163 (38)
Rehabilitation facility	405 (15)	248 (15)	87 (14)	70 (17)
Nursing home	759 (27)	462 (27)	162 (25)	135 (32)
Transfer to another acute care hospital	91 (3)	64 (4)	13 (2)	14 (3)
Other or unknown	307 (11)	182 (11)	83 (13)	42 (10)

P = 0,002

[a] $P<.001$ for both comparison of hyperoxia with normoxia and for hyperoxia with hypoxia.
[b] Defined as able to live at home and requiring no assistance to complete activities of daily living. $P=.002$ for comparison of hyperoxia with normoxia and $P=.10$ for comparison of hyperoxia with hypoxia.

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- Régression logistique multivariée
  - Hyperoxie = facteur prédictif indépendant de mortalité hospitalière

Table 5. Multiple Logistic Regression Model With In-Hospital Mortality as the Dependent Variable[a]

Variable	OR (95% CI)	*P* Value
Age decile	1.1 (1.1-1.2)	<.001
Emergency department origin	1.5 (1.3-1.7)	<.001
Nonindependent functional status at admission	1.3 (1.1-1.4)	<.001
Chronic renal failure	1.6 (1.3-1.9)	<.001
Active chemotherapy	2.8 (1.8-4.6)	<.001
High heart rate in ICU[b]	1.9 (1.7-2.1)	<.001
Hypotension at ICU arrival[c]	2.1 (1.9-2.3)	<.001
Hypoxia exposure	1.3 (1.1-1.5)	.009
Hyperoxia exposure	1.8 (1.5-2.2)	<.001

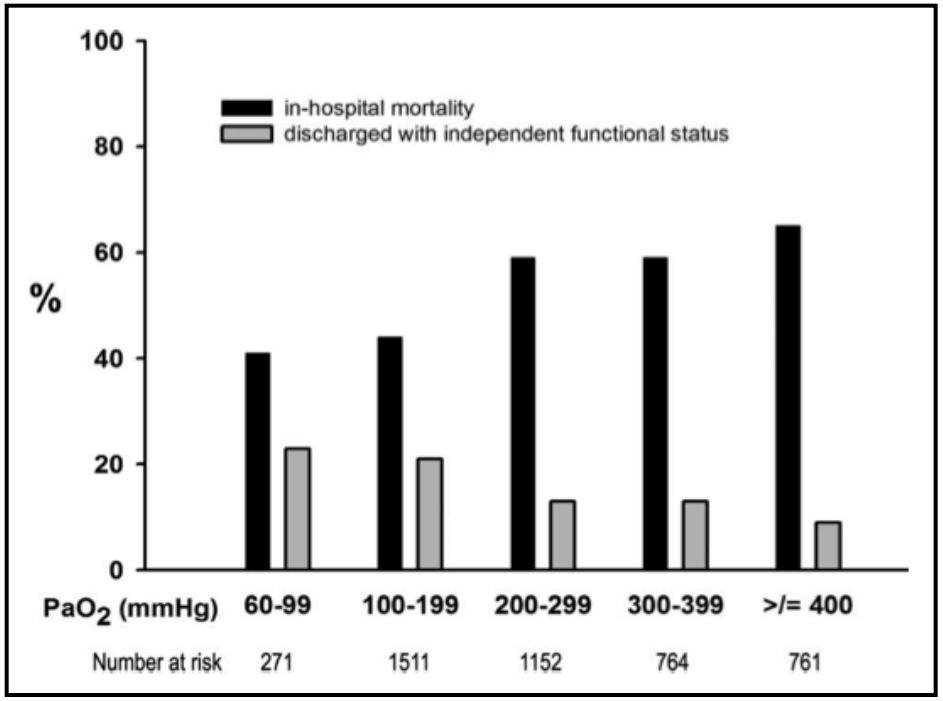
Relationship Between Supranormal Oxygen Tension and Outcome After Resuscitation From Cardiac Arrest

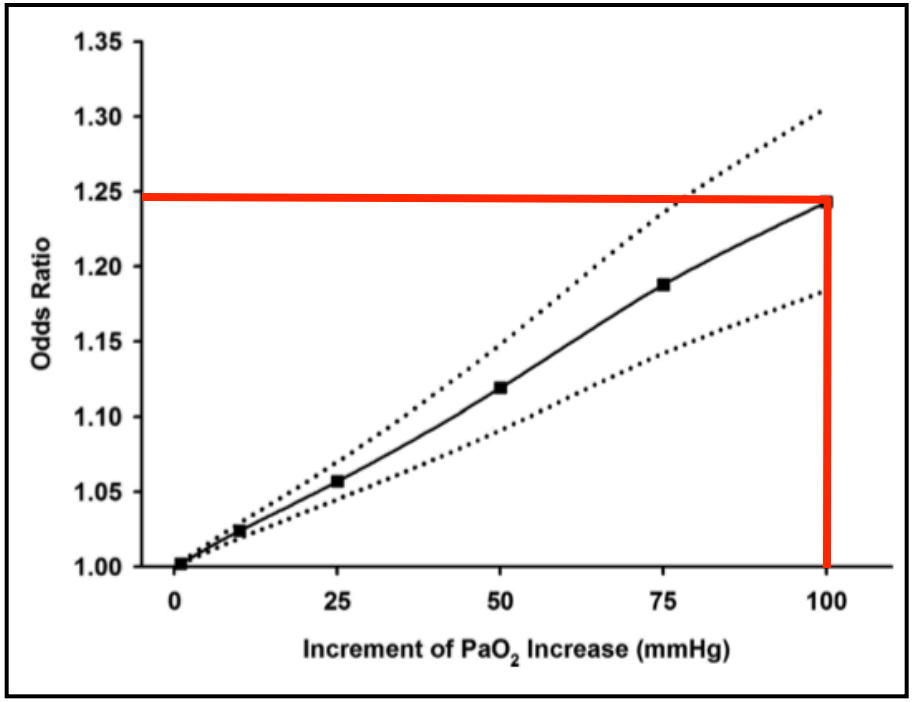
J. Hope Kilgannon, Alan E. Jones, Joseph E. Parrillo, R. Phillip Dellinger, Barry Milcarek, Krystal Hunter, Nathan I. Shapiro and Stephen Trzeciak

Circulation 2011, 123:2717-2722

American Heart Association®

- Analyse complémentaire de la cohorte du JAMA
  - n = 4459 patients après exclusion des patients hypoxiques
  - ↑ PaO_2 de 100 mmHg => ↑ mortalité de 24 %





RESEARCH Open Access

CRITICAL CARE

Arterial hyperoxia and in-hospital mortality after resuscitation from cardiac arrest

Bellomo *et al. Critical Care* 2011, **15**:R90

Rinaldo Bellomo[1*], Michael Bailey[1], Glenn M Eastwood[3], Alistair Nichol[1], David Pilcher[2], Graeme K Hart[2], Michael C Reade[3], Moritoki Egi[4], D James Cooper[1], the Study of Oxygen in Critical Care (SOCC) Group

- Cohorte prospective (ANZ Intensive Care Society)
  - 125 réanimations polyvalentes
  - Période d'étude = 2000-2009
  - 12 108 patients en RACS après ACEH non traumatique

- Méthodologie identique / Etude de Kilgannon et al.
  - Patients admis en réanimation après ACEH non traumatique
  - Classification *I* plus mauvais GDS des 24 premières heures
    - *Hyperoxie : $PaO_2 \geq 300$ mmHg*
    - *Normoxie : $60 < PaO_2 < 300$ mmHg*
    - *Hypoxie : $PaO_2 < 60$ mmHg*

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- Meilleur pronostic pour le groupe Normoxie
  - Pour la mortalité intra-hospitalière & la sortie vivant de l'hôpital
- Pronostic Hyperoxie et Hypoxie ~ équivalents
  - *Kilgannon et al. : pronostic Hyperoxie < Hypoxie < Normoxie*

Table 4 Outcomes of study patients

Patient outcomes	All patients (*N* = 12,108)	Hypoxia/poor O_2 exchange (*n* = 8,904)	Normoxia (*n* = 1,919)	Hyperoxia (*n* = 1,285)
In-hospital mortality[a], *n* (%) (95% CI)	6,968 (58) (57 to 58)	5,303 (60) (59 to 61)	911 (47) (45 to 50)	754 (59) (56 to 61)
Discharge destination for survivors, *n*	5,140	3,601	1,008	531
Home [a], *n* (%) (95% CI)	3,341 (28) (27 to 28)	2,350 (26) (25 to 27)	649 (34) (32 to 36)	342 (27) (24 to 29)
Rehabilitation facility	655 (5)	447 (5)	118 (6)	90 (7)
Transfer to another hospital	1,144 (9)	804 (9)	241 (13)	99 (8)

[a]$P < 0.0001$ for comparisons of normoxia with hyperoxia and normoxia with hypoxia in patients discharged to home.

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Rinaldo Bellomo[1*], Michael Bailey[1], Glenn M Eastwood[3], Alistair Nichol[1], David Pilcher[2], Graeme K Hart[2], Michael C Reade[3], Moritoki Egi[4], D James Cooper[1], the Study of Oxygen in Critical Care (SOCC) Group

Table 5 Multiple logistic regression model with in-hospital mortality as dependent variable using EMShockNet model variables[a]

Variable	OR (95%CI)	*P* value
Acute renal failure	3.3 (2.9 to 3.7)	<0.0001
Hypotension in first 24 hours[b]	1.9 (1.7 to 2.0)	<0.0001
Age, decile	1.1 (1.1 to 1.1)	<0.0001
Emergency department origin	1.6 (1.4 to 1.7)	<0.0001
High heart rate[c]	1.5 (1.3 to 1.6)	<0.0001
Hypoxia/poor O_2 exchange versus normoxia	1.4 (1.3 to 1.6)	<0.0001
Hyperoxia versus normoxia	1.5 (1.3 to 1.8)	<0.0001
Cancer	2.0 (1.5 to 2.5)	<0.0001
Cirrhosis	2.2 (1.5 to 3.1)	<0.0001
Female sex	1.2 (1.1 to 1.3)	<0.0001
Chronic renal	1.4 (1.1 to 1.6)	0.001
Chronic respiratory disease	1.3 (1.1 to 1.5)	0.002
Hepatic failure	2.7 (1.3 to 5.9)	0.01

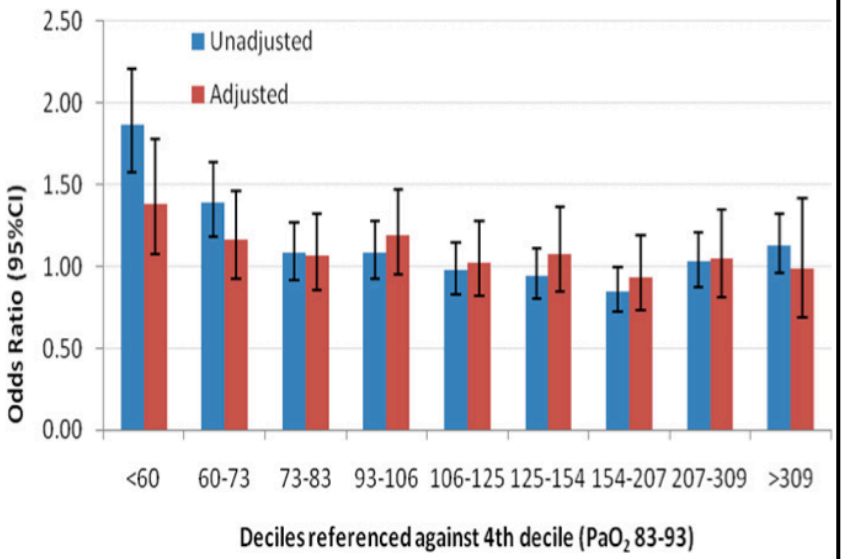

Figure 1 Odds ratios for hospital mortality by deciles of PaO_2.

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Key messages

- When the worst set of arterial blood gases is used for assessment, hyperoxia is uncommon in the first 24 hours after ICU admission in patients resuscitated from cardiac arrest.
- Using the same approach, isolated hypoxemia is just as common.
- Hyperoxia in these patients has a weak, model-dependent and nonreproducible association with mortality.
- Unless accurate and reliable pulse oximetry is available to prevent hypoxemia, a policy of reducing FiO_2 to avoid possible hyperoxia is not justified and may not be prudent.

Recommandations 2010

Part 9: Post–Cardiac Arrest Care : 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Mary Ann Peberdy, Clifton W. Callaway, Robert W. Neumar, Romergryko G. Geocadin, Janice L. Zimmerman, Michael Donnino, Andrea Gabrielli, Scott M. Silvers, Arno L. Zaritsky, Raina Merchant, Terry L. Vanden Hoek and Steven L. Kronick

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association.

Adult Immediate Post–Cardiac Arrest Care

Return of Spontaneous Circulation (ROSC)

↓

Optimize ventilation and oxygenation

- Maintain oxygen saturation ≥94%
- Consider advanced airway and waveform capnography
- Do not hyperventilate

Doses/Details

Ventilation/Oxygenation
Avoid excessive ventilation. Start at 10-12 breaths/min and titrate to target P_{ETCO_2} of 35-40 mm Hg.
When feasible, titrate F_{IO_2} to minimum necessary to achieve Sp_{O_2} ≥94%.

« It is recognized that titration of inspired oxygen may not be possible immediately after out-of-hospital cardiac arrest until the patient is transported to the emergency department or, in the case of in-hospital arrest, the intensive care unit (ICU). »

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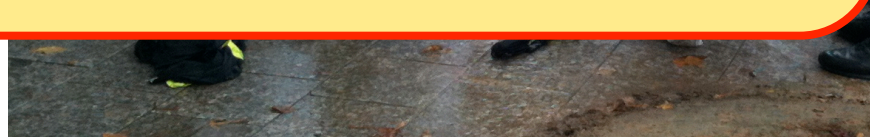
Adult Immediate Post–Cardiac Arrest Care

« ~~It is recognized that~~ Titration of inspired oxygen may ~~not~~ be possible immediately after out-of-hospital cardiac arrest ~~until patient is transported to the emergency department or, in case of in-hospital arrest,~~ in the mobile intensive care unit (MICU). »



Paramedics

MICU = Mobile ICU

Conclusion

- Oxygénation pendant la RCP
  - FiO_2 100% +++
- Oxygénation après RACS
  - Probable effet délétère de l'hyperoxie
  - Arguments expérimentaux
  - Peu d'études cliniques
  - Mais déjà des recommandations internationales
- Objectif = Normoxie dès la phase préhospitalière