Hyperoxie: le nouvel ennemi des urgentistes?

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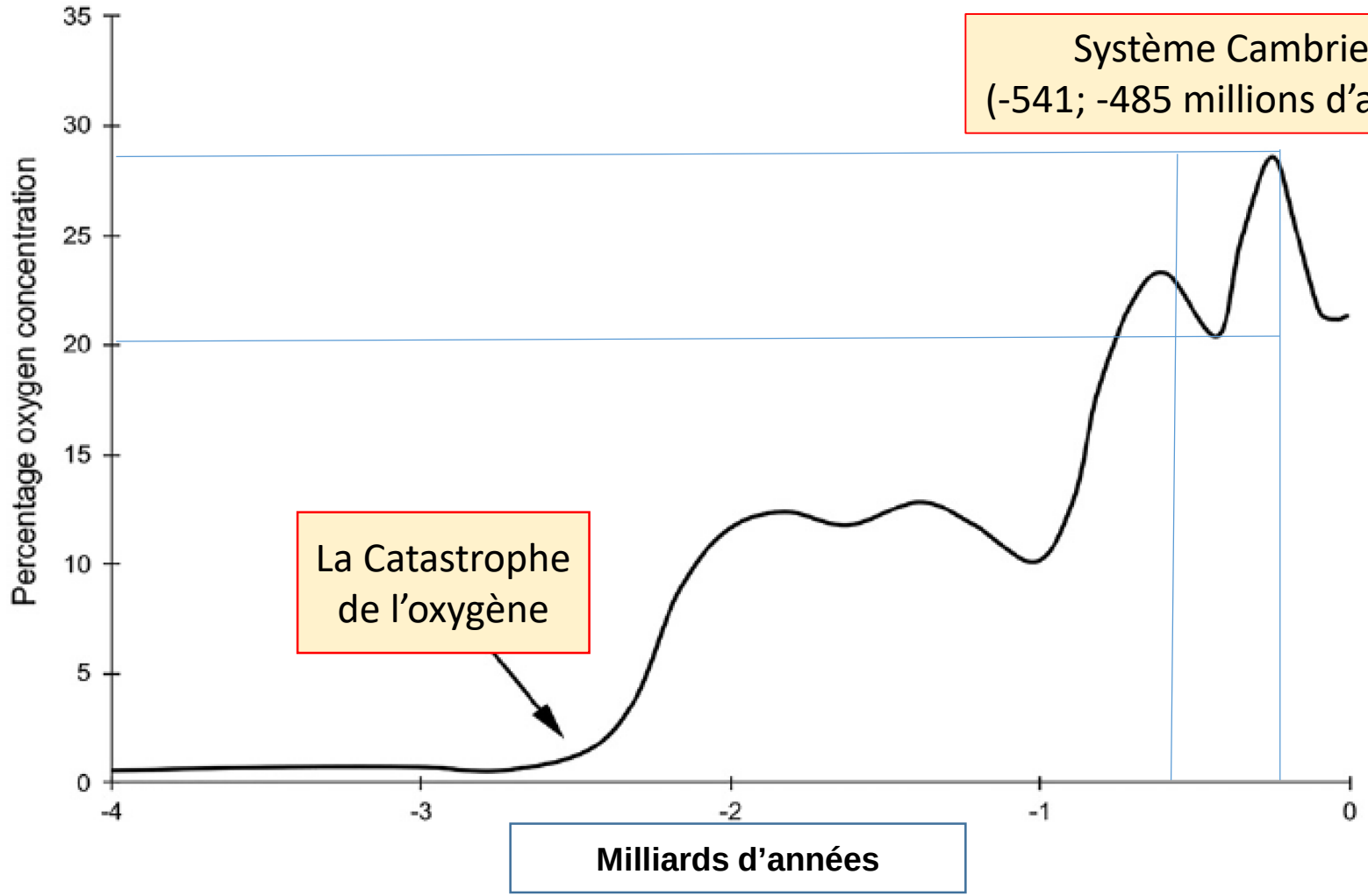
Histoire de l'oxygène sur notre bonne vieille planète



- Produit par cyanobactéries
- Responsable de la destruction des autres bactéries et d'un refroidissement planétaire
- Produit la couche d'ozone
- Finalement ne laisse survivre que les espèces résistantes à la toxicité de l'oxygène (eucaryotes, mitochondries…)

Mesurer l'oxygénation du sang

- **$C_aO_2 = Hb.S_aO_2 + P_aO_2$**
  - $Hb.S_aO_2$ représente 98% du CaO_2 donc on peut approximer $CaO_2 = Hb.SaO_2$
  - S_aO_2 représente donc le l'oxygène mobilisable et constitue une bonne mesure du contenu en oxygène du sang
- Mesurer Hb: NFS ou hémocue veineux®
- Déterminant: la SpO_2

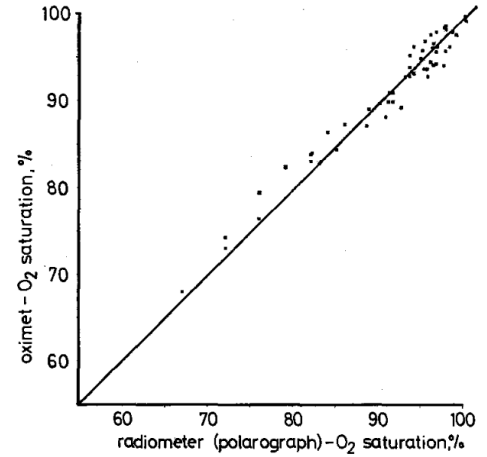


Fig. 6 Comparison of oxygen saturation measured with the present oximeter (ordinate) and the blood-gas method (abscissa). The diagonal line is of identity

Brugniaux JV. Am Physiol Regul Integr Comp Physiol 2018, Feb 28

Relation SpO_2 – PaO_2

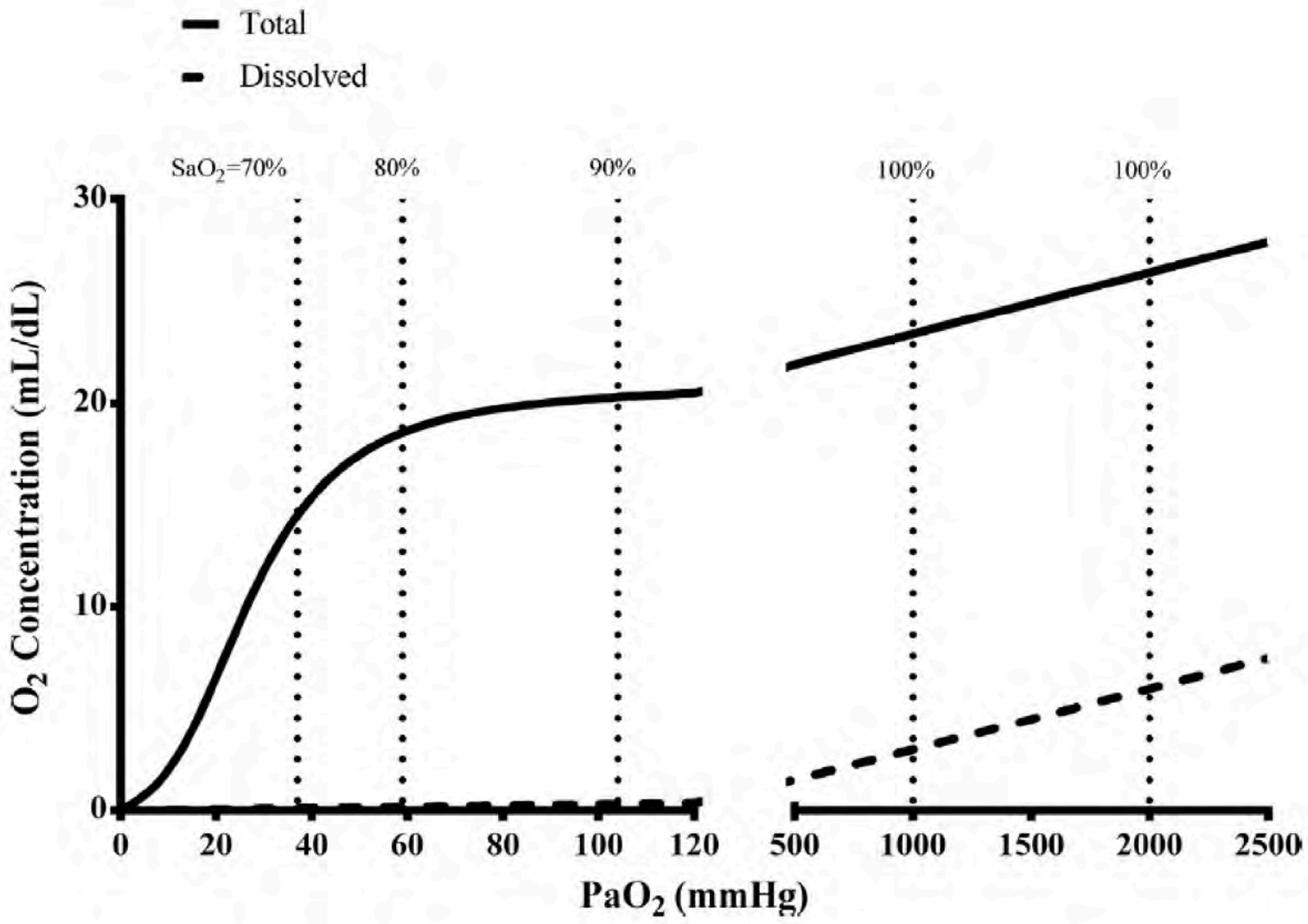


Fig. 4. Relationship between arterial oxygen content (Ca_{O_2}) and arterial O_2-hemoglobin (Hb) saturation (Sa_{O_2}) for a range of arterial partial pressure of O_2 (Pa_{O_2}) from 0 to 2,500 mmHg (achievable via hyperbaric hyperoxia). Note that values were calculated for a given Pa_{O_2} using the Severinghaus equation (247) and a Hb value of 15 g/100 ml (i.e., normal for males).

Mécanisme de toxicité: stress oxydatif

- Dépasse les barrières anti-oxydante cellulaire
  - Casse équilibre oxydant/antioxydant
  - Superoxide dismutase, catalase…
- Via les ROS (réactive oxygen species)
  - Peroxidation des lipides
  - Dégradation de l'ADN (oxydation)
  - Altères les molécules biologiques
- Très cytotoxiques
  - Mort cellulaire par apoptose
  - Relargage des DAMPs (*damage associated molecular pattern molecules*)
  - Stimulation inappropriée d'une réponse inflammatoire (IL6, TNFα)

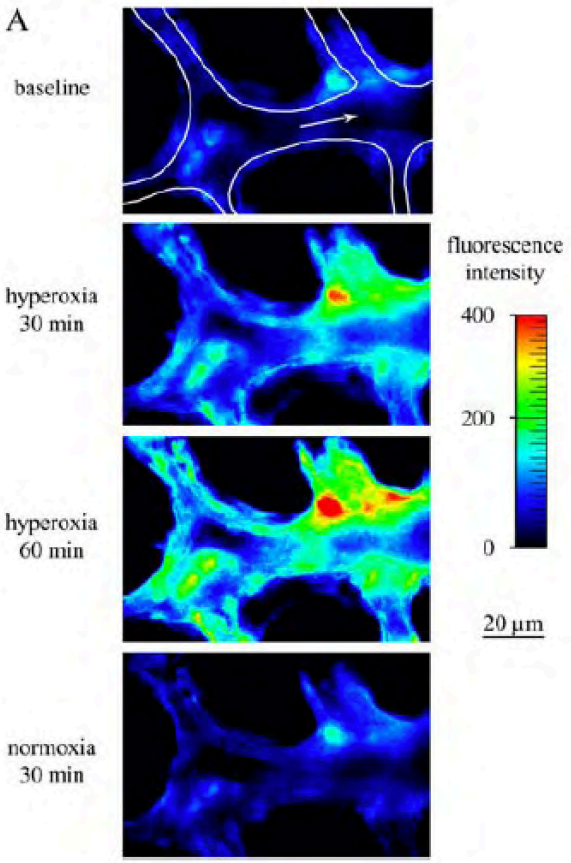
Mécanisme de toxicité: vasoconstriction

- Diminution des niveaux de NO endogène
  - Consommation de NO
  - Production de peroxydonitrites très cytotoxique
- Diminution de la perfusion capillaire (distale)
- Mécanisme de défense pour diminuer la perfusion d'O_2?
- ➔Cérébrale
- ➔Coronarienne

Exposition/lésions en peu de temps!

Hyperoxia-Induced Reactive Oxygen Species Formation in Pulmonary Capillary Endothelial Cells *In Situ*

Corinna Brueckl, Stephanie Kaestle, Alexander Kerem, Helmut Habazettl, Fritz Krombach, Hermann Kuppe,



Marqueur d'espèces moléculaires du stress oxydatif (ROS)

- IL6
- TNFα

Am J Respir Cell Mol Biol Vol 34. pp 453–463, 2006

Time course of inflammation, oxidative stress and tissue damage induced by hyperoxia in mouse lungs

Akinori C. Nagato*, Frank S. Bezerra†, Manuella Lanzetti*, Alan A. Lopes*, Marco Aurélio S. Silva*,

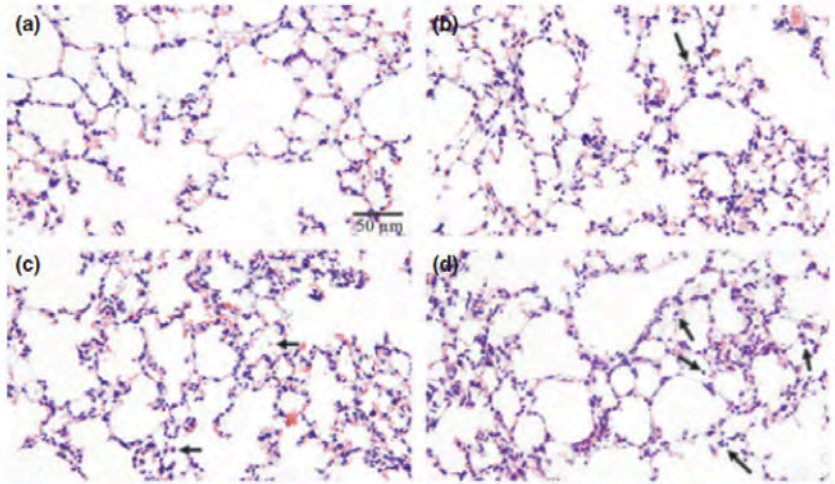
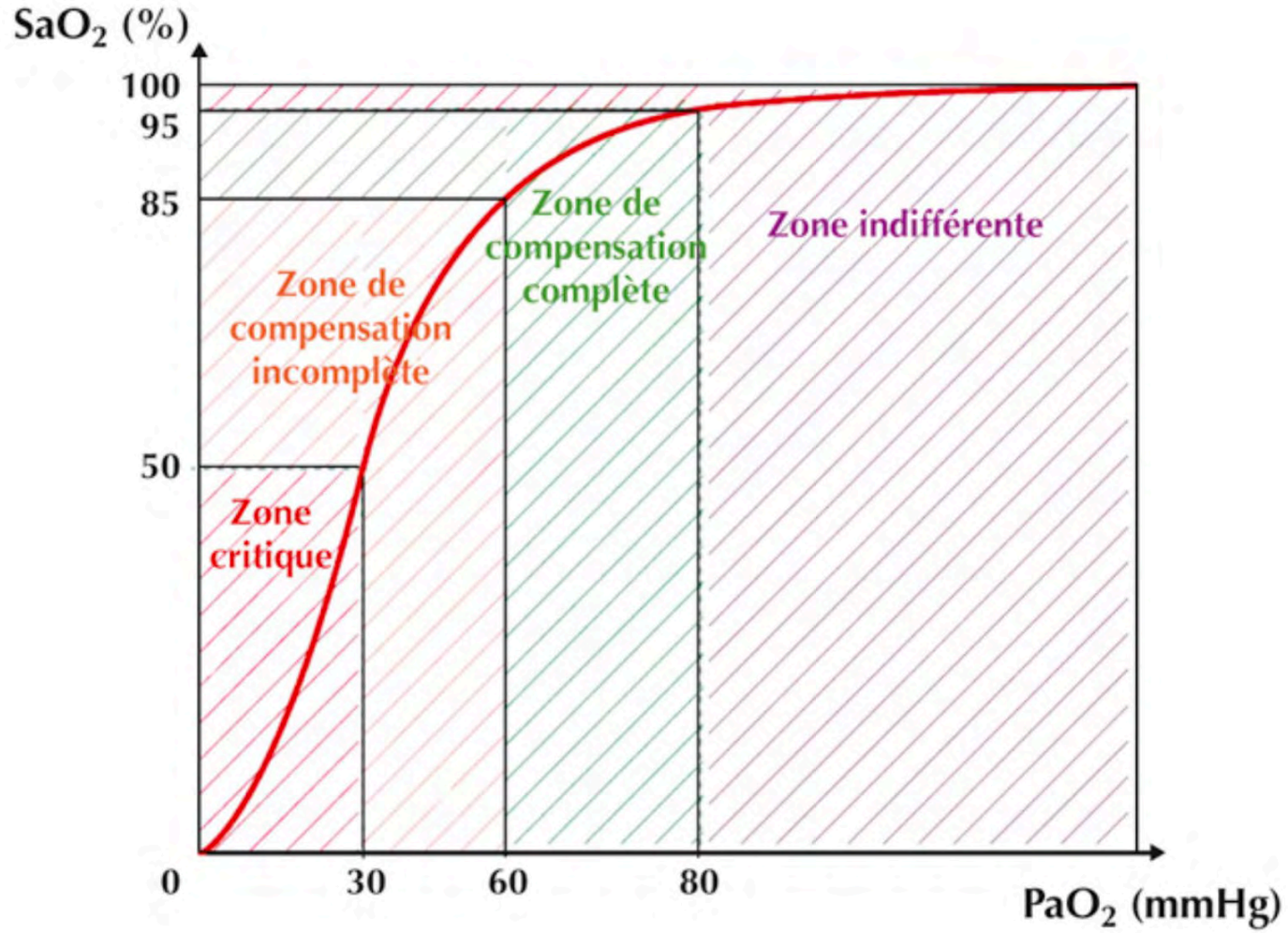


Table 2 Inflammatory scores of mouse lungs exposed to 100% oxygen for 12, 24 and 48 h

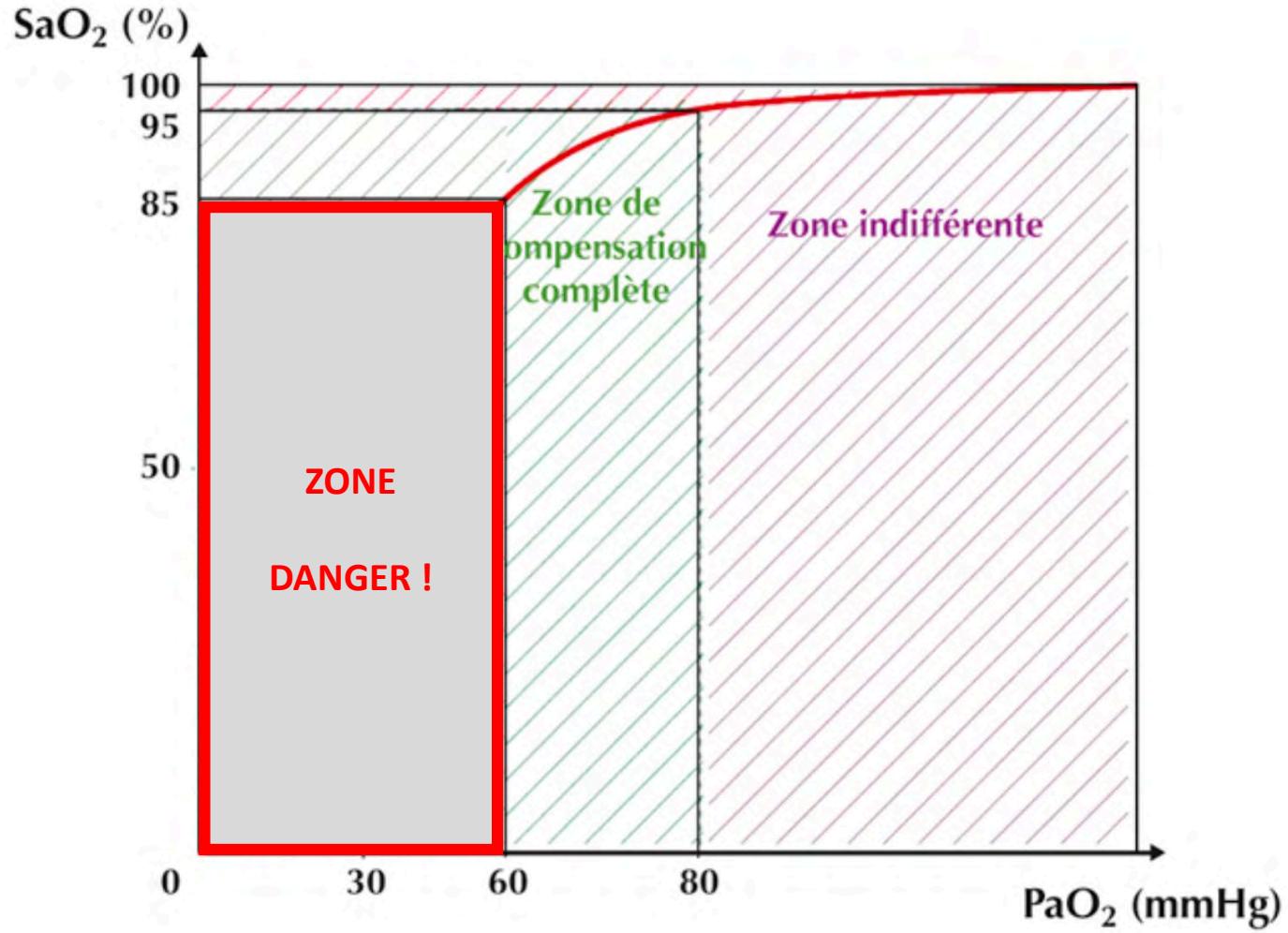
Groups	Alveolar congestion	Haemorrhage	Infiltration of leucocytes	Alveolar wall thickness
Control	–	–	–	–
12 h	–	–	2	–
24 h	2	–	2	–
48 h	2	3	3	2

Int. J. Exp. Path. (2012), 93, 269–278

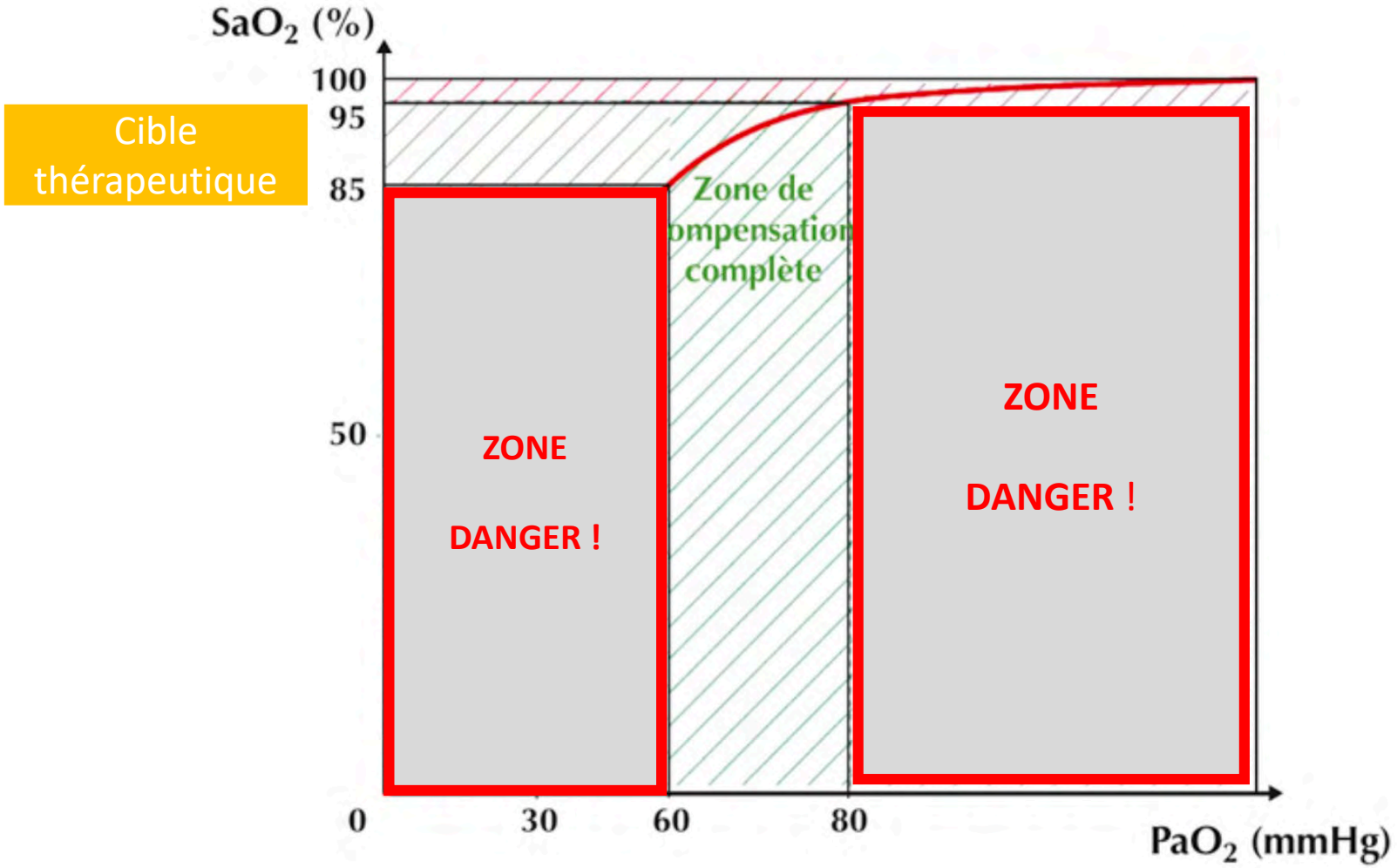
SaO_2/PaO_2


SaO2 (%)
100
95
85
50
0
30
60
80
PaO2 (mmHg)
Zone de compensation incomplète
Zone critique
Zone de compensation complète
Zone indifférente

SaO_2/PaO_2


SaO2 (%)
100
95
85
50
0
30
60
80
PaO2 (mmHg)
Zone de compensation complète
Zone indifférente
ZONE
DANGER !

SaO_2/PaO_2


SaO2 (%)
100
95
85
50
0
30
60
80
PaO2 (mmHg)
Cible thérapeutique
Zone de compensation complète
ZONE DANGER !
ZONE DANGER !

Comme le mentionnait Paracelse, il y a plus de 400 ans :

"Toutes les substances sont toxiques, il n'y a aucune qui n'est pas toxique. C'est la dose qui fait la différence entre une substance toxique et un remède ».

Review Article

Harmful Effects of Hyperoxia in Postcardiac Arrest, Sepsis, Traumatic Brain Injury, or Stroke: The Importance of Individualized Oxygen Therapy in Critically Ill Patients

Jean-Louis Vincent,[1] Fabio Silvio Taccone,[1] and Xinrong He[2]

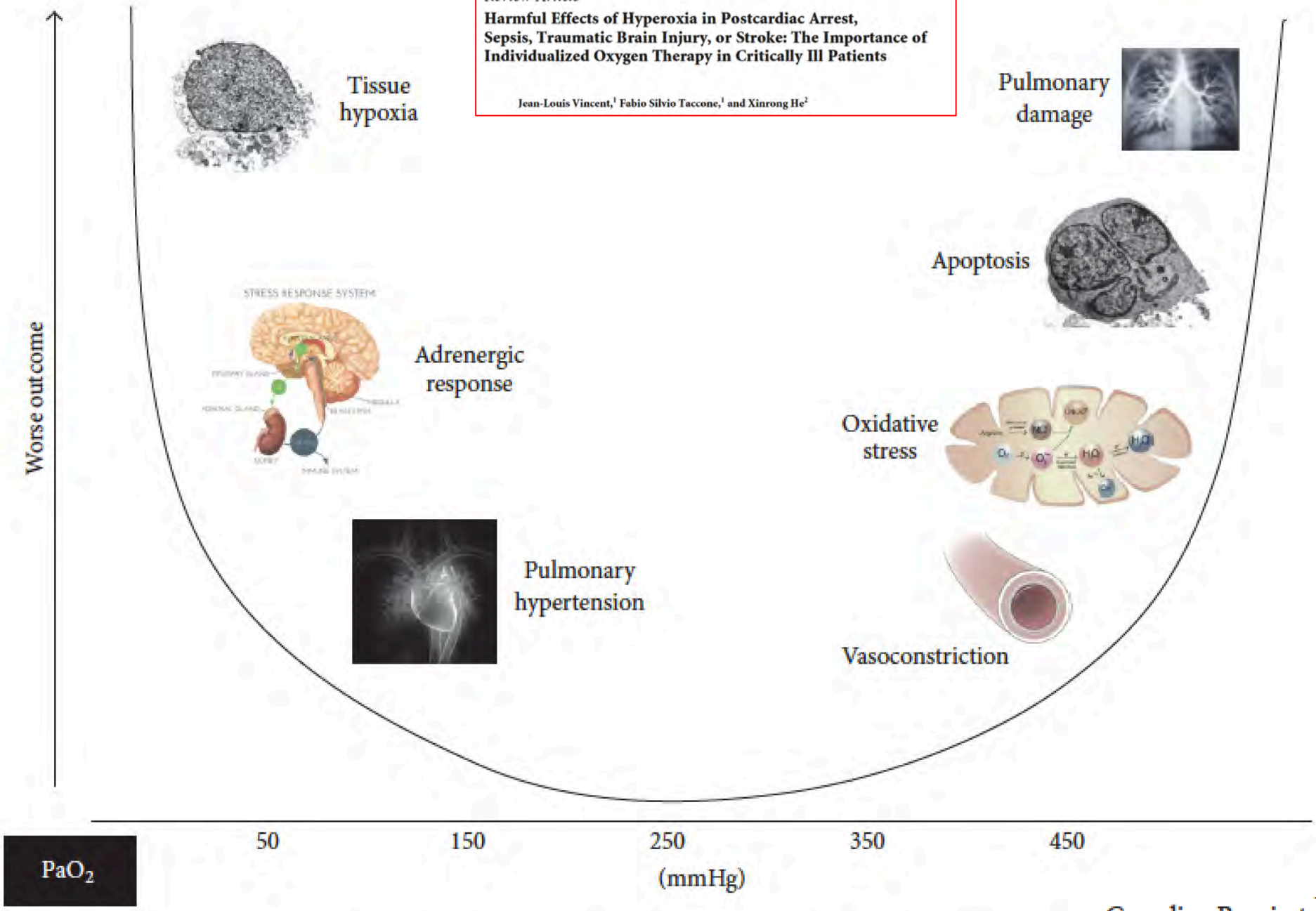
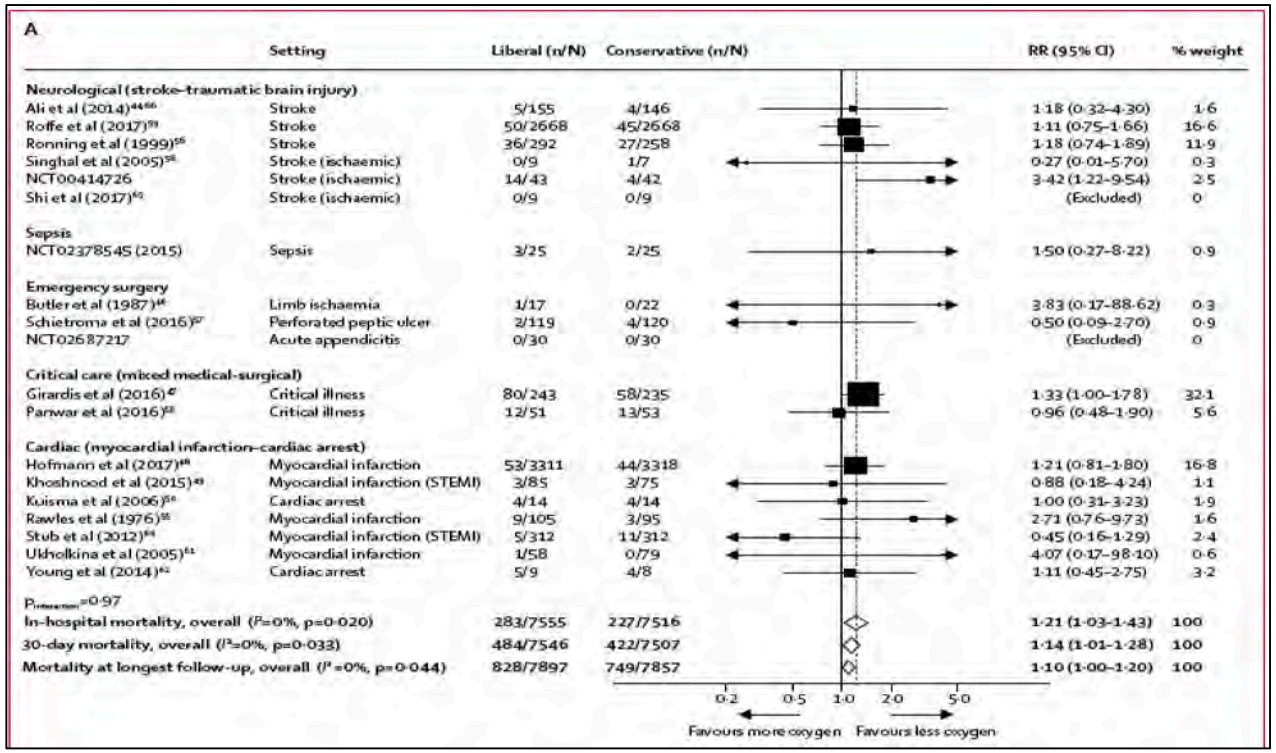


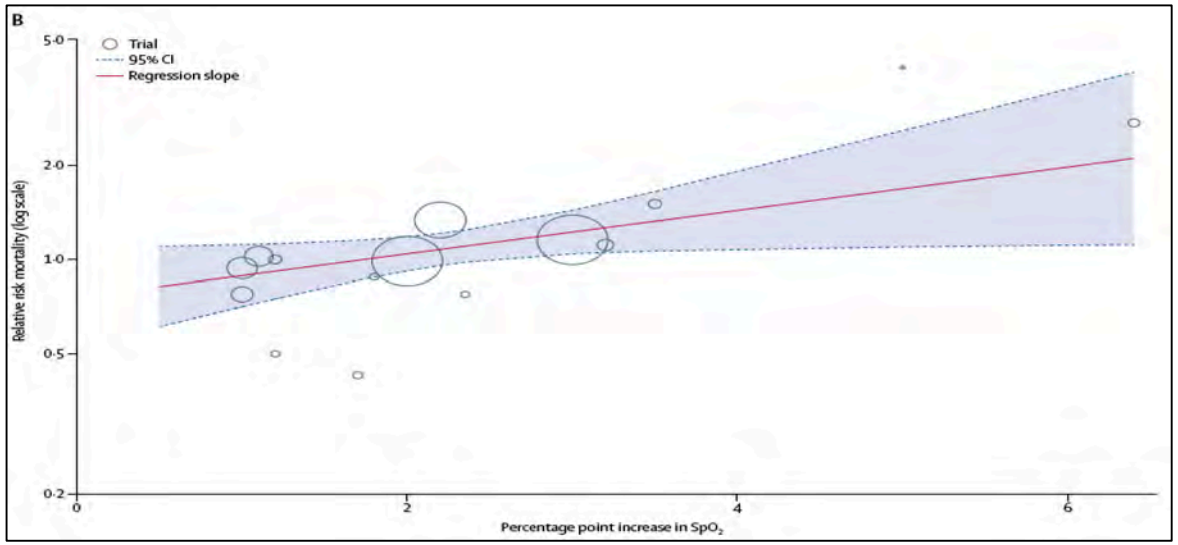
FIGURE 1: Schematic showing U-shaped association of PaO_2 with outcome.

Mortality and morbidity in acutely ill adults treated with liberal versus conservative oxygen therapy (IOTA): a systematic review and meta-analysis

Lancet 2018; 391: 1693–705

Derek K Chu*†, Lisa H-Y Kim*†, Paul J Young, Nima Zamiri, Saleh A Almenawer, Roman Jaeschke, Wojciech Szczeklik, Holger J Schünemann, John D Neary, Waleed Alhazzani





Interpretation In acutely ill adults, high-quality evidence shows that liberal oxygen therapy increases mortality without improving other patient-important outcomes. Supplemental oxygen might become unfavourable above an SpO_2 range of 94–96%. These results support the conservative administration of oxygen therapy.

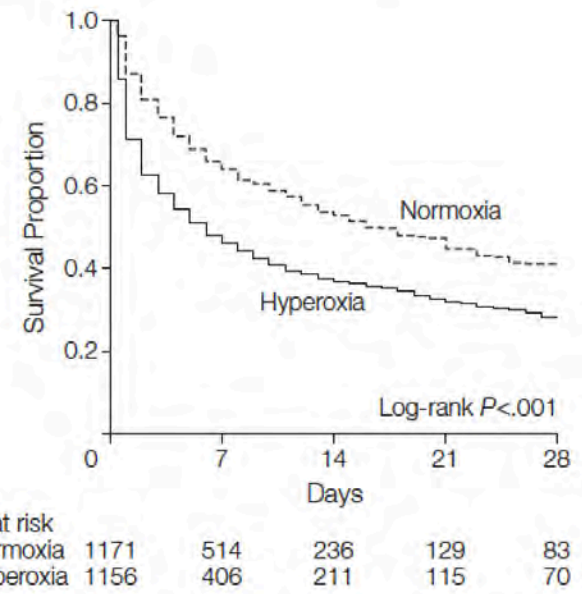
Hyperoxie et ACR récupéré

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

J. Hope Kilgannon, MD

Context Laboratory investigations suggest that exposure to hyperoxia after resuscita-

Figure. In-Hospital Death Between Hyperoxia and Normoxia



N=6326, registre

PaO2 > 300 vs <300 et > 60 mmHg

Mortalité 63% vs. 45%

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

Hyperoxie et AVC

Association Between Hyperoxia and Mortality After Stroke: A Multicenter Cohort Study*

Fred Rincon, MD, MSc, MBE, FACP, FCCP, FCCM[1,2]; Joon Kang, MD[1]; Mitchell Maltenfort, PhD[3];

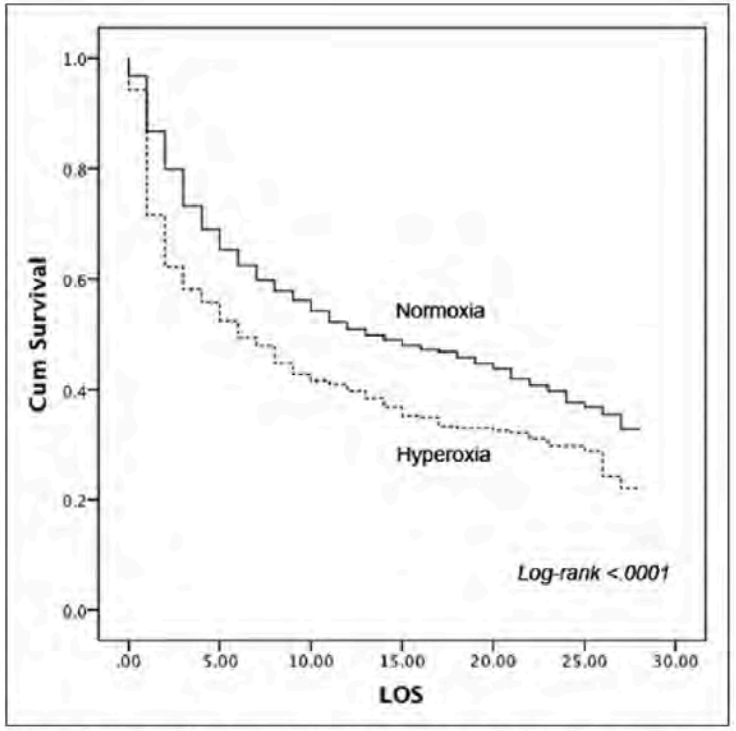


Figure 2. Kaplan-Meier analysis of 28-d mortality between hyperoxia

N=280
PaO_2 ≥300 vs <300 et > 60 mmHg

Crit Care Med 2014;42:387-396

Early Moderate Hyperoxemia Does Not Predict Outcome After Aneurysmal Subarachnoid Hemorrhage

TABLE 2. Unadjusted 3-Month Outcome[a]

Variable	All Patients (N = 432)	Low (n = 106)	Intermediate (n = 192)	High (n = 104)	P
Median GOS (IQR)	3 (1-5)	4 (1-5)	3 (1-5)	3 (1-4)	.02
Unfavorable outcome[b]	227 (52)	43 (41)	101 (53)	83 (61)	.01
Mortality	121 (28)	27 (26)	57 (30)	37 (27)	.77

[a]GOS, Glasgow Outcome Scale; IQR, interquartile range. Categorical data are presented as n (%) and continuous data as median (IQR). Low is defined as PaO_2 <97.5 mm Hg, intermediate as PaO_2 97.5 to 150 mm Hg, and high as PaO_2 ≥150 mm Hg.
[b]Defined as GOS score of 1 to 3.

N=432
PaO_2 > 150 vs. <150 et > 97.5 mmHg

Neurosurgery. 2016;78:540-545.

Hyeproxie et infarctus du myocarde

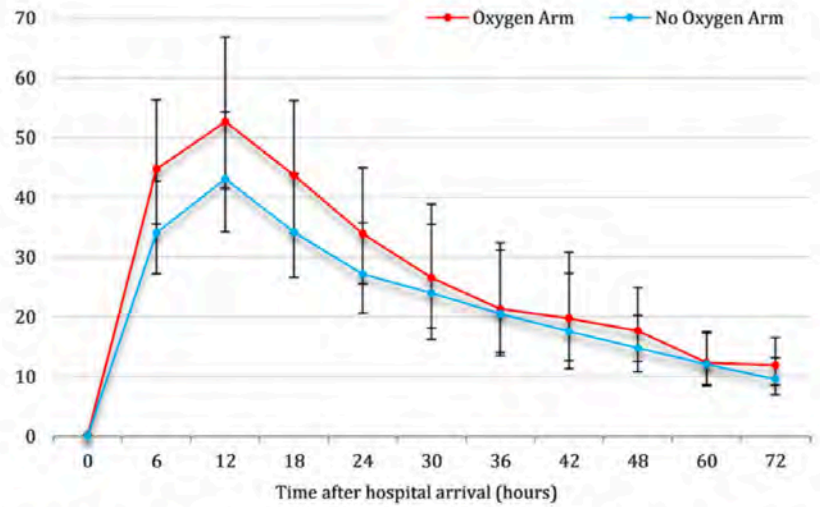


Figure 2. Geometric mean (95% confidence interval) for cardiac troponin I (cTnI) release (μg/L) over 72 hours in patients with confirmed ST-segment–elevation myocardial infarction. A

N=441
O_2 8 L/min vs. air

Circulation. 2015;131:2143-2150

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Oxygen Therapy in Suspected Acute Myocardial Infarction

Robin Hofmann, M.D., Stefan K. James, M.D., Ph.D.,

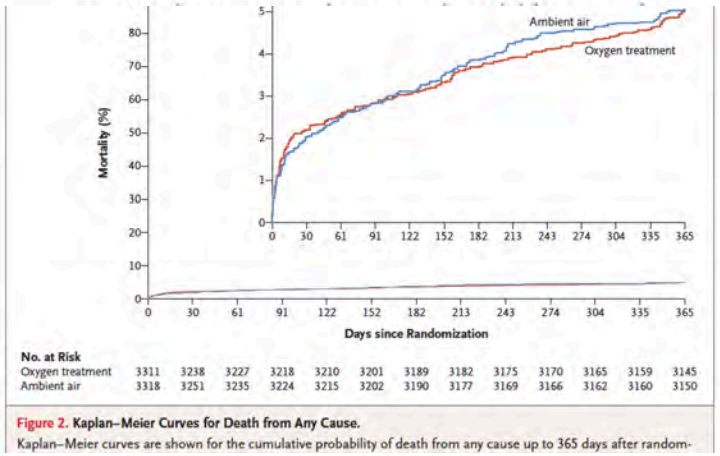


Figure 2. Kaplan–Meier Curves for Death from Any Cause.
Kaplan–Meier curves are shown for the cumulative probability of death from any cause up to 365 days after random-

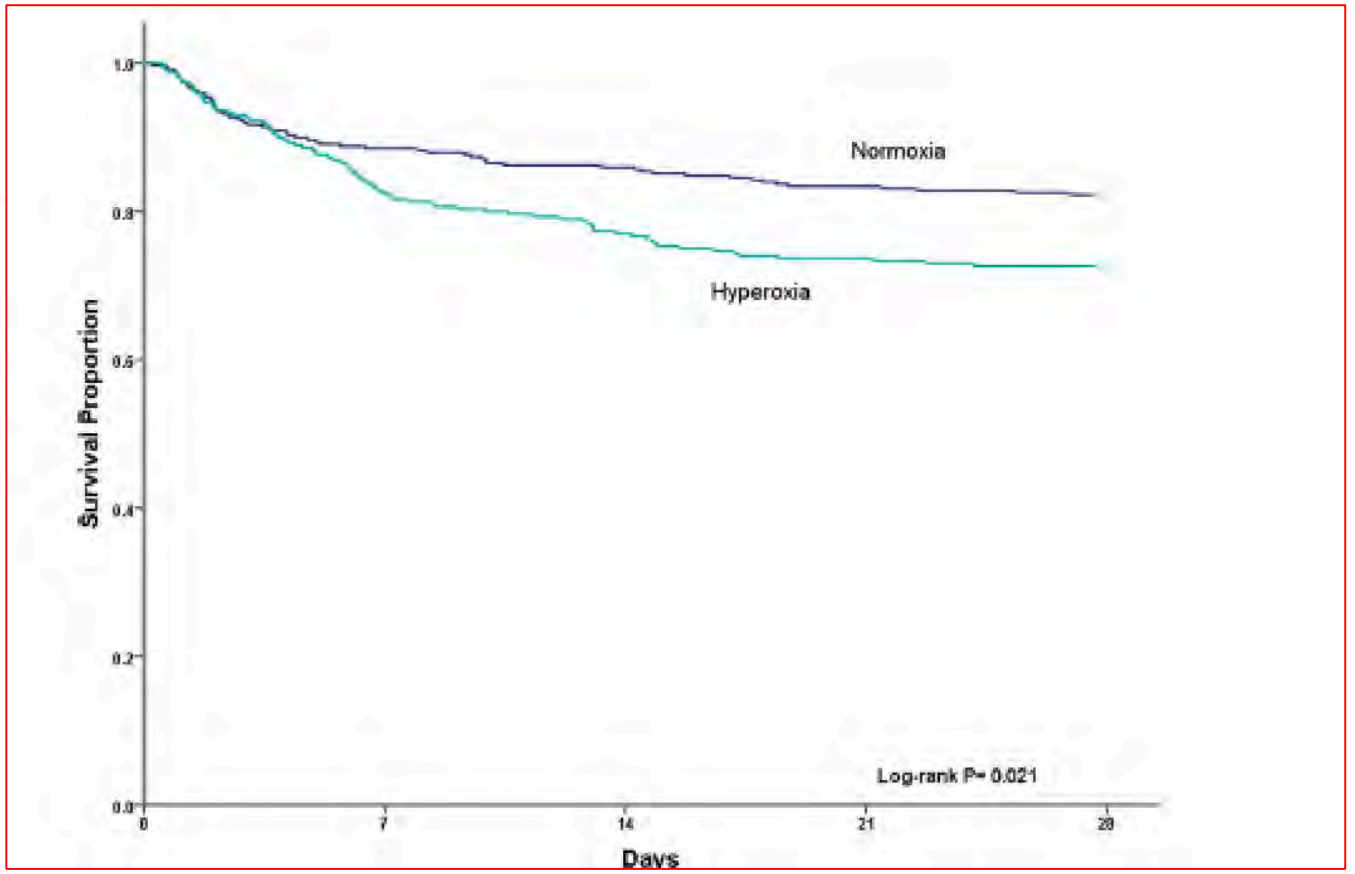
N=6629
O_2 6 L/min vs air
SpO2 = 99% vs. 97%

NEJM 2017;377:1240-1249

Patients des services d'urgences

Emergency department hyperoxia is associated with increased mortality in mechanically ventilated patients: a cohort study

David Page[3], Enyo Ablordeppey[1,2], Brian T. Wessman[1,2], Nicholas M. Mohr[4,5], Stephen Trzeciak[6,7], Marin H. Kollef[3], Brian W. Roberts[7] and Brian M. Fuller[1,2*]



N=688, observationnel, monocentrique
PaO_2 > 120 vs. <120 et > 60 mm Hg
Patients ventilés
Mortalité 30% vs. 19%

Page *et al. Critical Care* (2018) 22:9

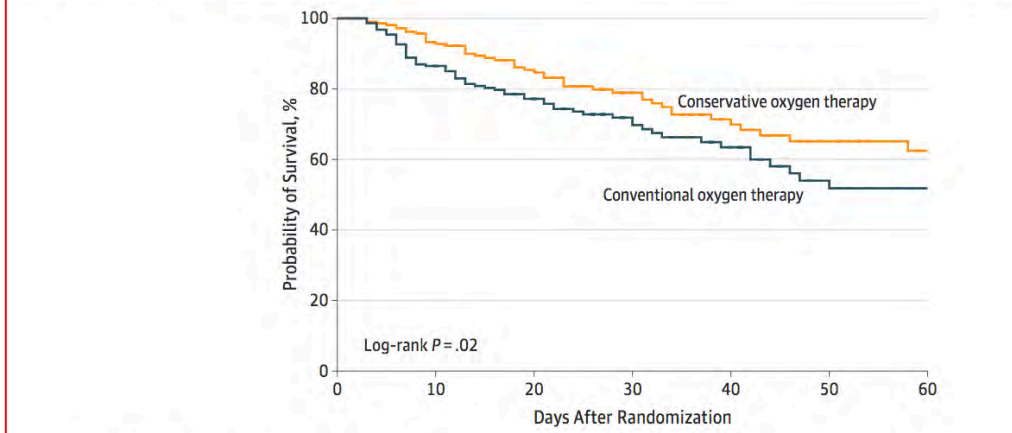
Réanimation

JAMA | Preliminary Communication | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Conservative vs Conventional Oxygen Therapy on Mortality Among Patients in an Intensive Care Unit
The Oxygen-ICU Randomized Clinical Trial

Massimo Girardis, MD; Stefano Busani, MD; Elisa Damiani, MD; Abele Donati, MD; Laura Rinaldi, MD; Andrea Marudi, MD;

Figure 2. Probability of Survival From Study Inclusion (Day 0) Through Day 60 for Patients in the Conservative and Conventional Oxygen Strategy Groups



No. at risk							
Conservative oxygen therapy	216	201	188	181	173	170	169
Conventional oxygen therapy	218	189	172	163	158	152	152

N=484, RCT, cible:
SpO_2 94-98% vs. > 97%
Mortalité 20 vs. 11%

JAMA. 2016;316:1583-1589

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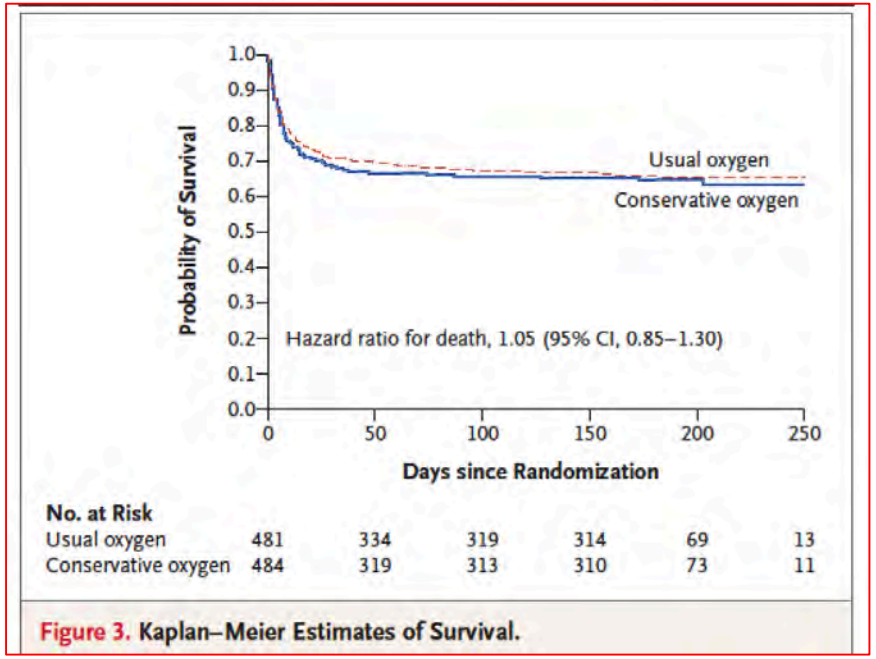
ORIGINAL ARTICLE

Conservative Oxygen Therapy during Mechanical Ventilation in the ICU

The ICU-ROX Investigators and the Australian and New Zealand Intensive Care



No. at Risk						
Usual oxygen	481	334	319	314	69	13
Conservative oxygen	484	319	313	310	73	11

Figure 3. Kaplan–Meier Estimates of Survival.

N=1000, RCT, cible:
SpO_2 91-97 vs. > 91%

NEJM 2019; october 17.

Patients traumatisés

Hyperoxemia is associated with lower mortality after severe trauma: a registry study

Josefine S. Baekgaard;[1,2] Marouane Boubaya;[3] Paer-Selim Abback;[4] Jean-Denis Moyer;[4] Delphine Garrigue[5]; Mathieu Raux[6]; Benoit Champigneulle[7]; Sophie Hamada[8]; Julien Pottecher[9]; Philippe Laitselart[10]; Fleur Laloum[11]; Lars S. Rasmussen;[1] Coralie Bloch-Queyrat;[3] Jacob Steinmetz[12]; Anatole Harrois[8]; Frédéric Adnet;[1] Catherine Paugam[4], Traumabase® Group

N=5912, registre Traumabase®
PaO2 > 150 vs. < 150 et > 60 mmHg

Figure 2
In-hospital mortality in normoxemic and hyperoxemic trauma patients using a propensity score model

Methods		PaO_2< 150 mmHg n= 3342	PaO_2≥ 150 mmHg n= 2570	OR (95% CI)	p-value
Without adjustment				1.31 [1.11-1.56]	0.002
Propensity score	IPTW	291/3342	286/2570	0.60 [0.51-0.71]	<0.0001
	1:1	255/1975	177/1975	0.63 [0.51-0.78]	0.0002
	Stratified	291/3342	286/2570	0.63 [0.51-0.71]	<0.0001

* Adjusted for sex, age, prehospital heart rate and systolic blood pressure, temperature, creatinine, hemoglobin, lactate, airway management (intubated or not), catecholamine administration, fluid replacement therapy, TBI, initial GCS score, ASA>1 and the presence of hemorrhagic shock.
IPTW: Inverse probability of treatment weighting; 1:1: One-to-one matching; Stratified: Stratified

Conclusion

- Prudence sur la FiO_2
- Cible SpO_2 entre 94-97% : QSP O_2 pour…
- Littérature très contradictoire
- SpO_2 seule cible de l'oxygénation

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Publicité


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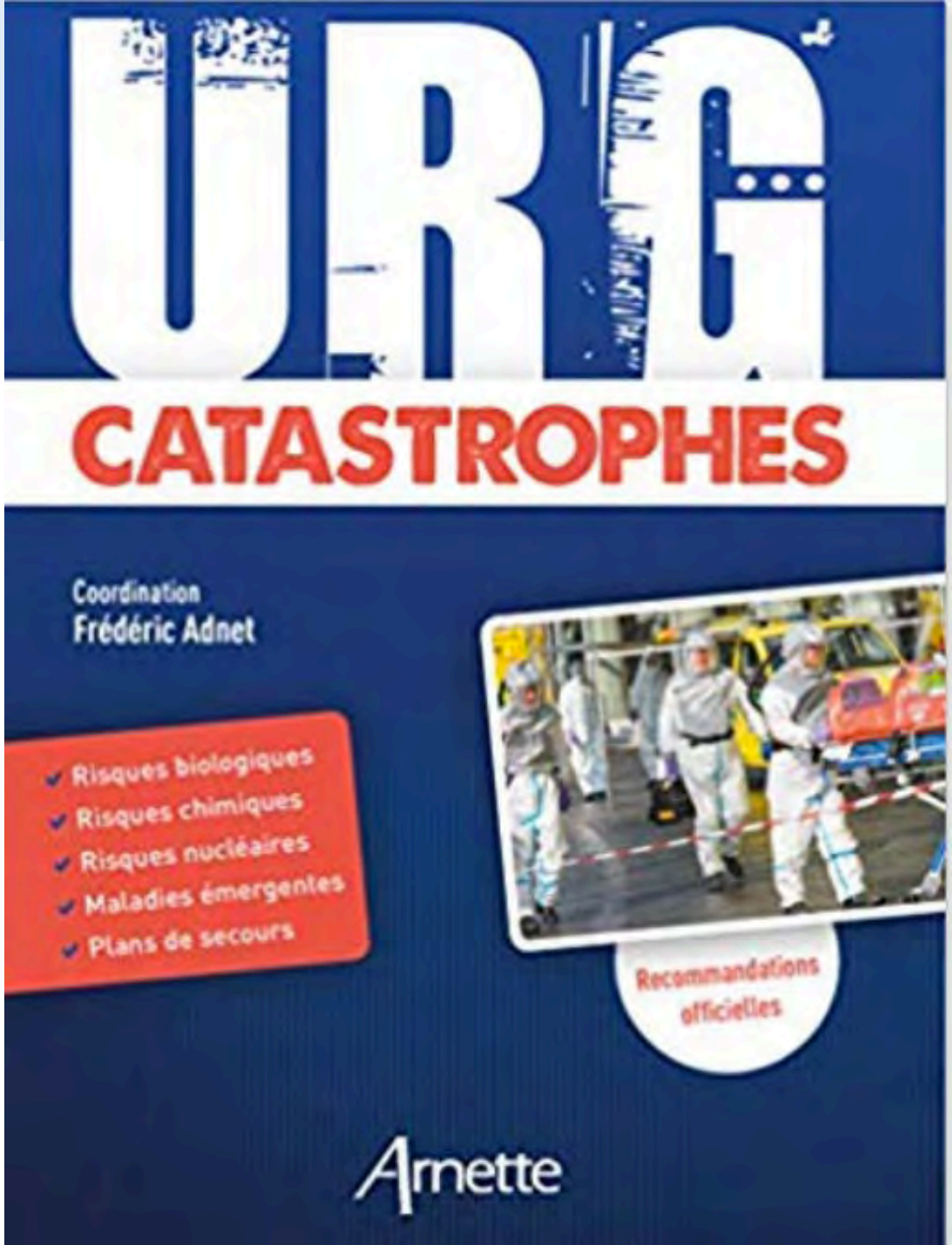
5e édition
2019
2020
Coordination
Frédéric Adnet
Application offerte à l'achat du livre !
Arnette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