OXYGENATION

PIERRE CATOIRE

CCA – Urgences, SAMU et SMUR (CHU Bordeaux)

PIERRE CATOIRE

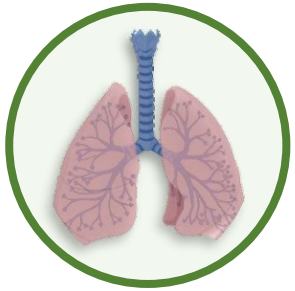
CCA – Urgences, SAMU et SMUR (CHU Bordeaux)

COI ?

404

not found

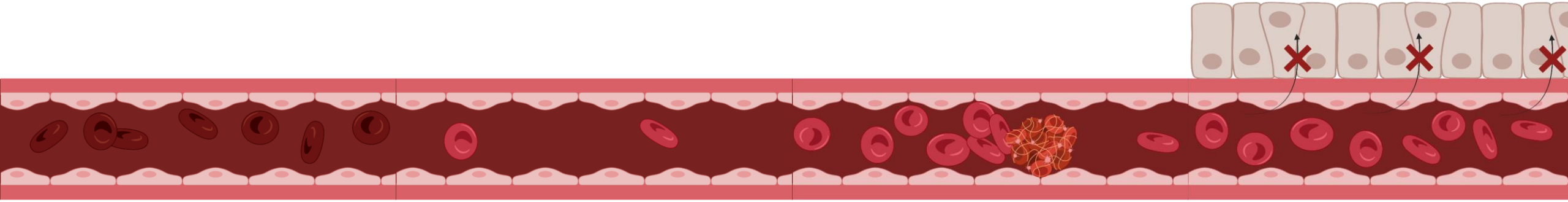
MENU



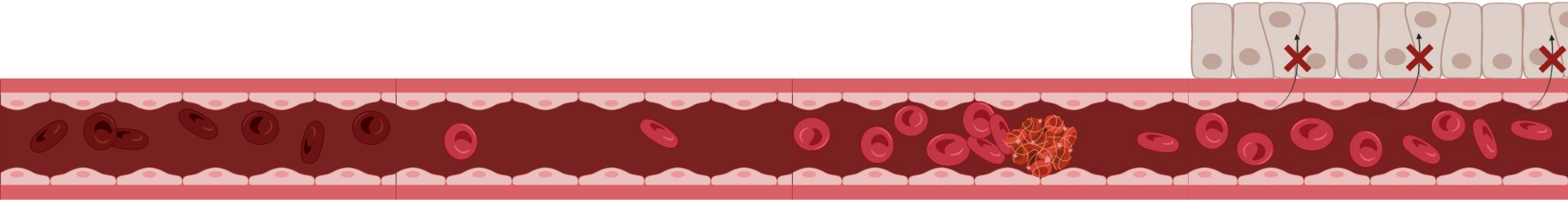
Physiologie de l’hématose

Cibles et indices d’oxygénation

Vecteurs d’oxygénothérapie

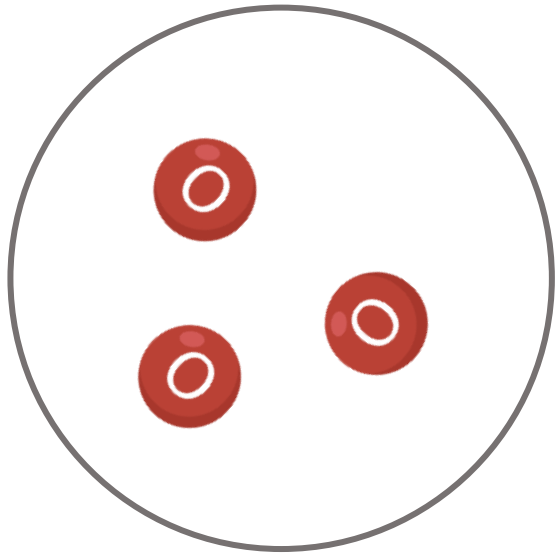


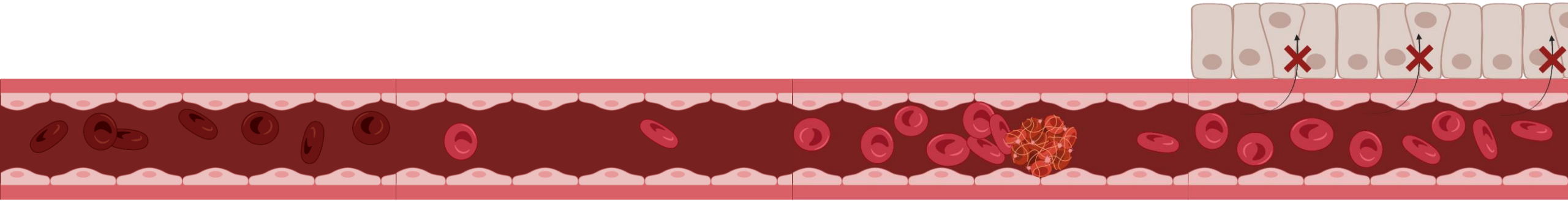
Hypoxie hypoxémique **Hypoxie anémique** **Hypoxie ischémique** **Hypoxie cytotoxique**



Hypoxie hypoxémique | **Hypoxie anémique** | **Hypoxie ischémique** | **Hypoxie cytotoxique**

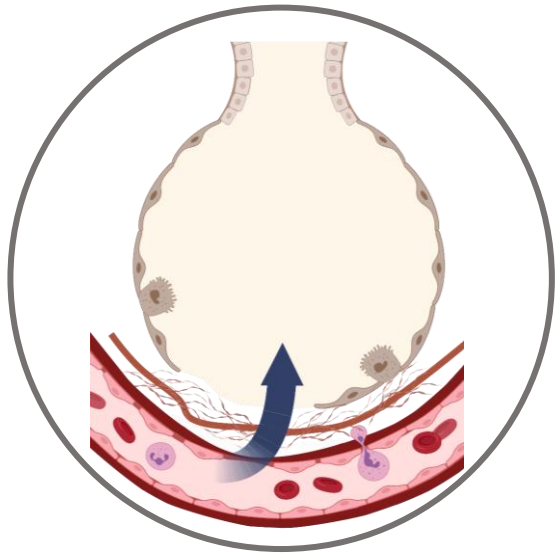
→ **Diminution de la PiO2**

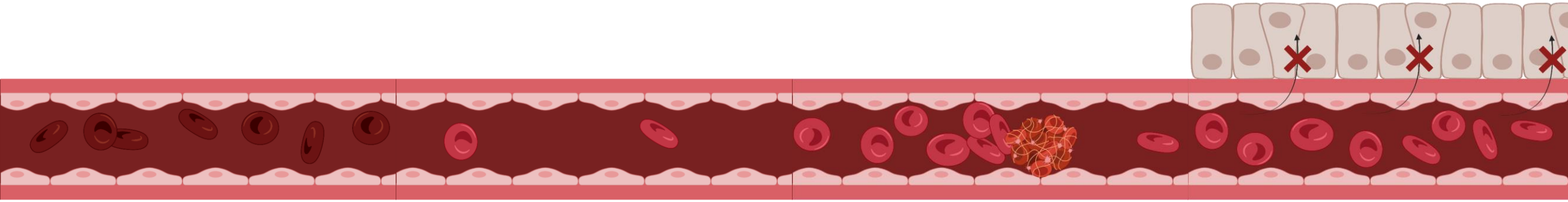




Hypoxie hypoxémique | **Hypoxie anémique** | **Hypoxie ischémique** | **Hypoxie cytotoxique**

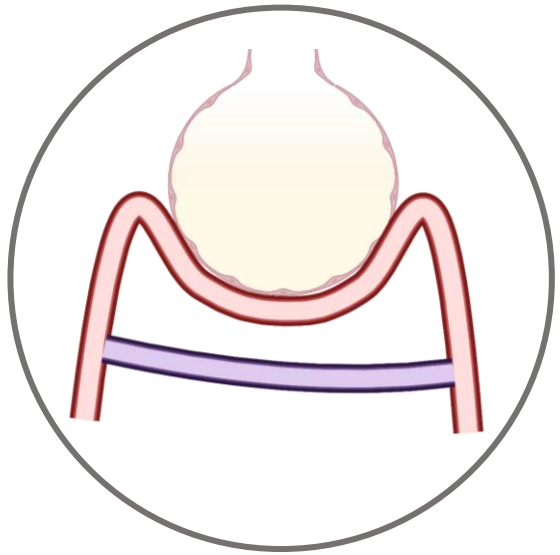
- **Diminution de la PiO2**
- **Limitation de la diffusion**

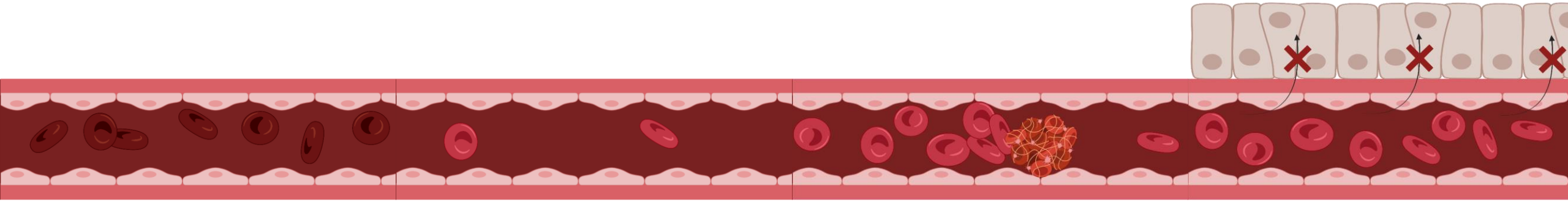




Hypoxie hypoxémique | **Hypoxie anémique** | **Hypoxie ischémique** | **Hypoxie cytotoxique**

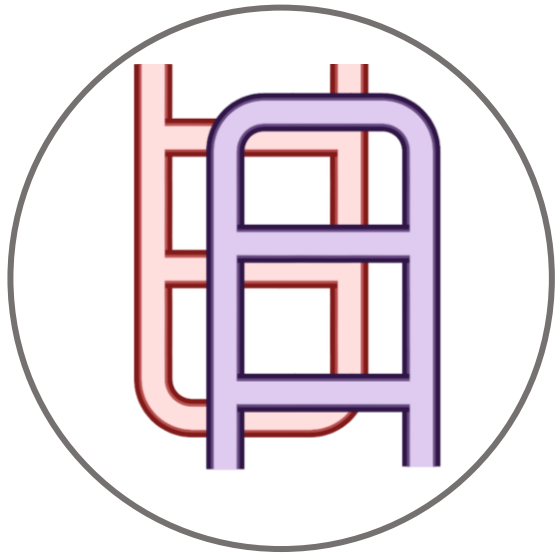
- **Diminution de la PiO2**
- **Limitation de la diffusion**
- **Shunt**



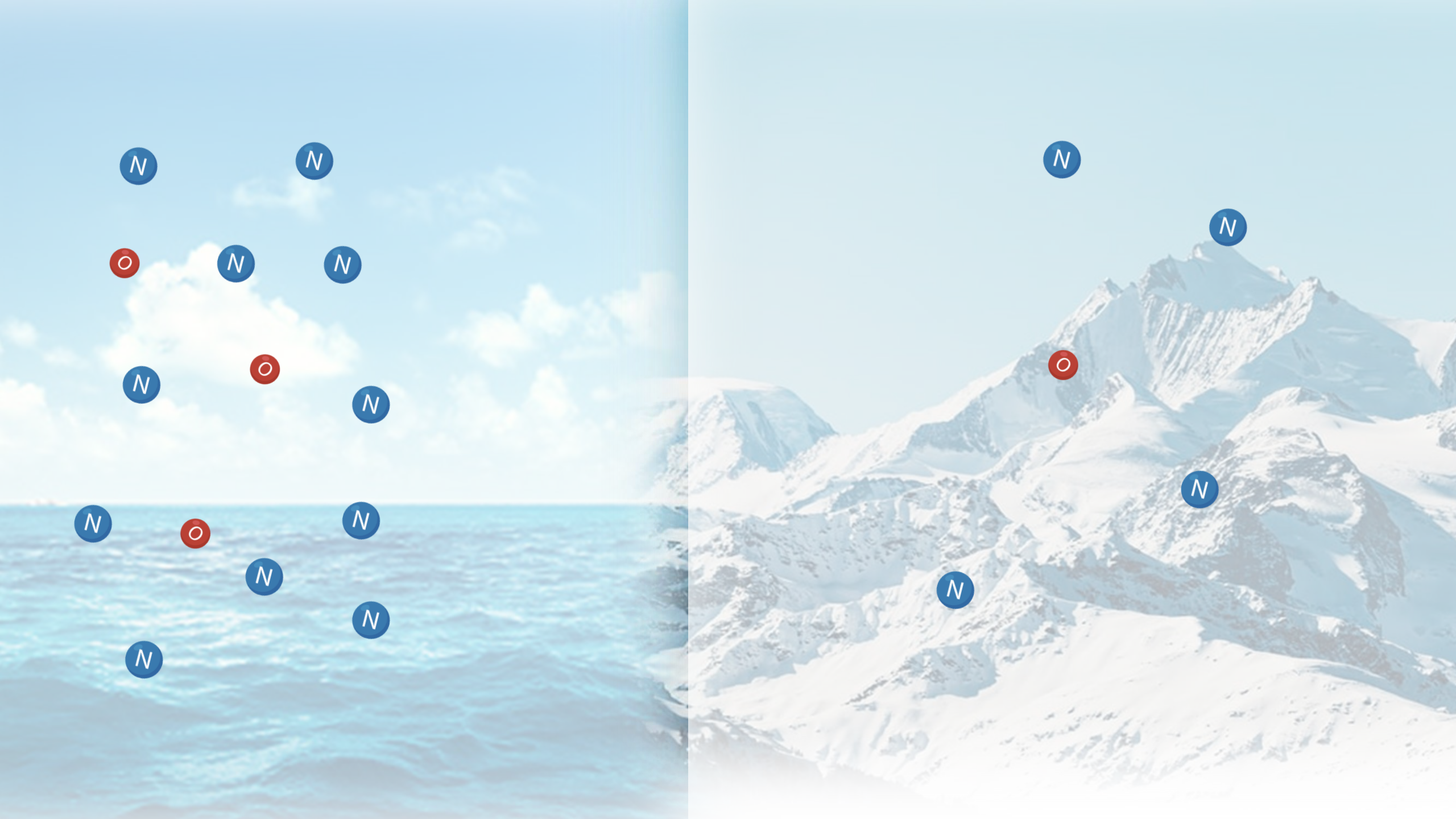


Hypoxie hypoxémique | **Hypoxie anémique** | **Hypoxie ischémique** | **Hypoxie cytotoxique**

- **Diminution de la PiO2**
- **Limitation de la diffusion**
- **Shunt**
- **Mismatch ventilation-perfusion**



QU’EST-CE QUE L’EFFET SHUNT ?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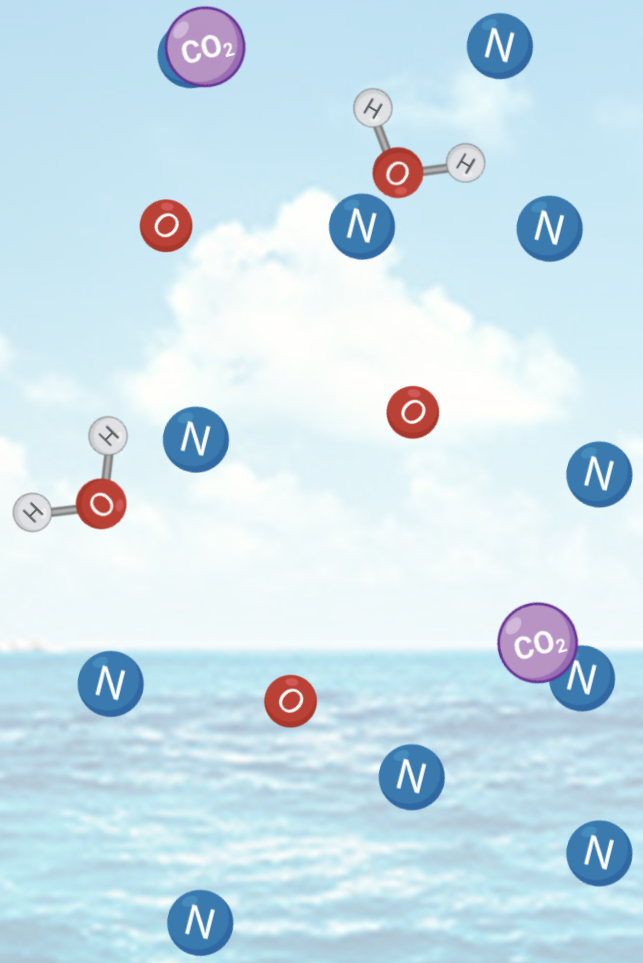
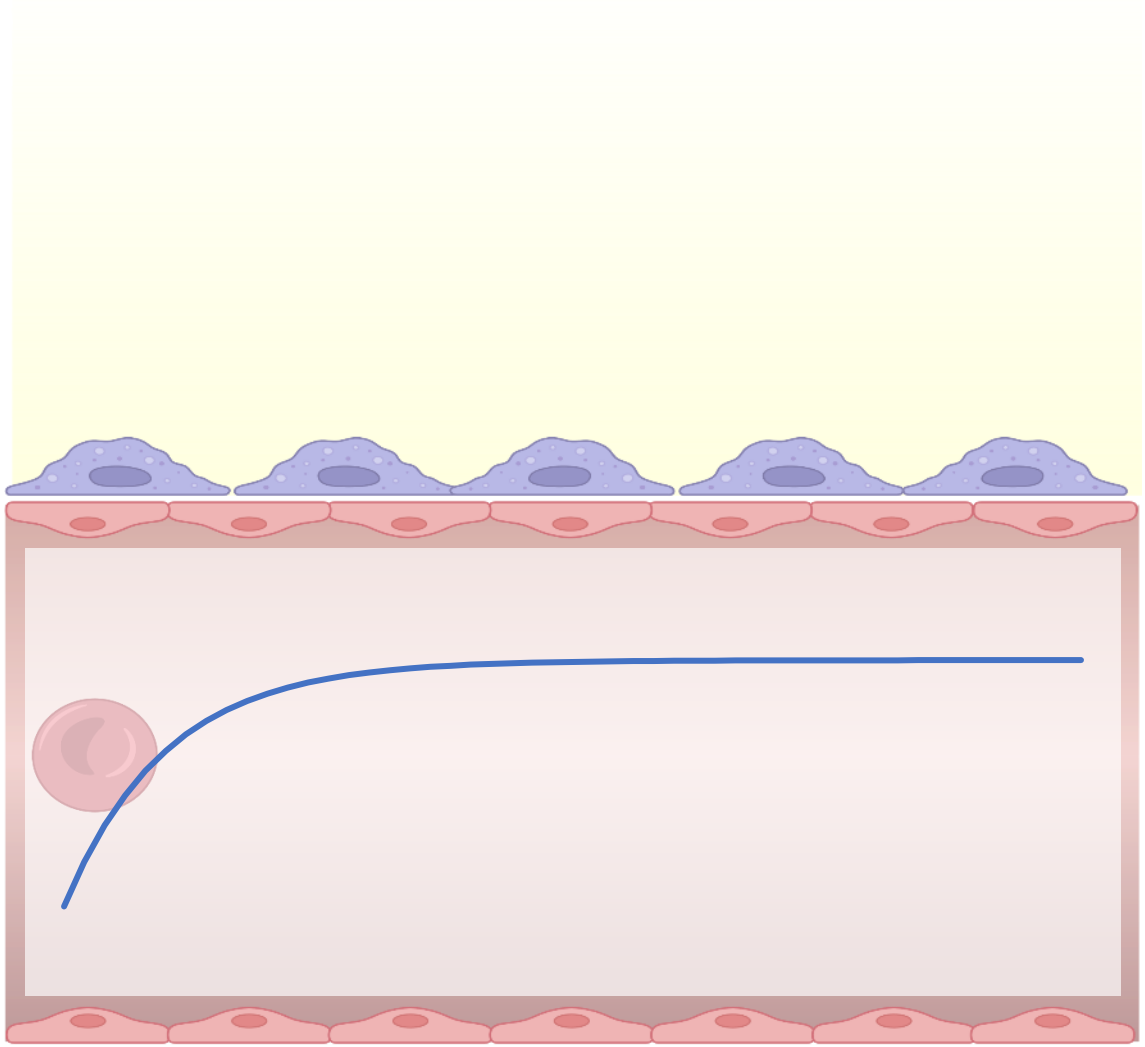
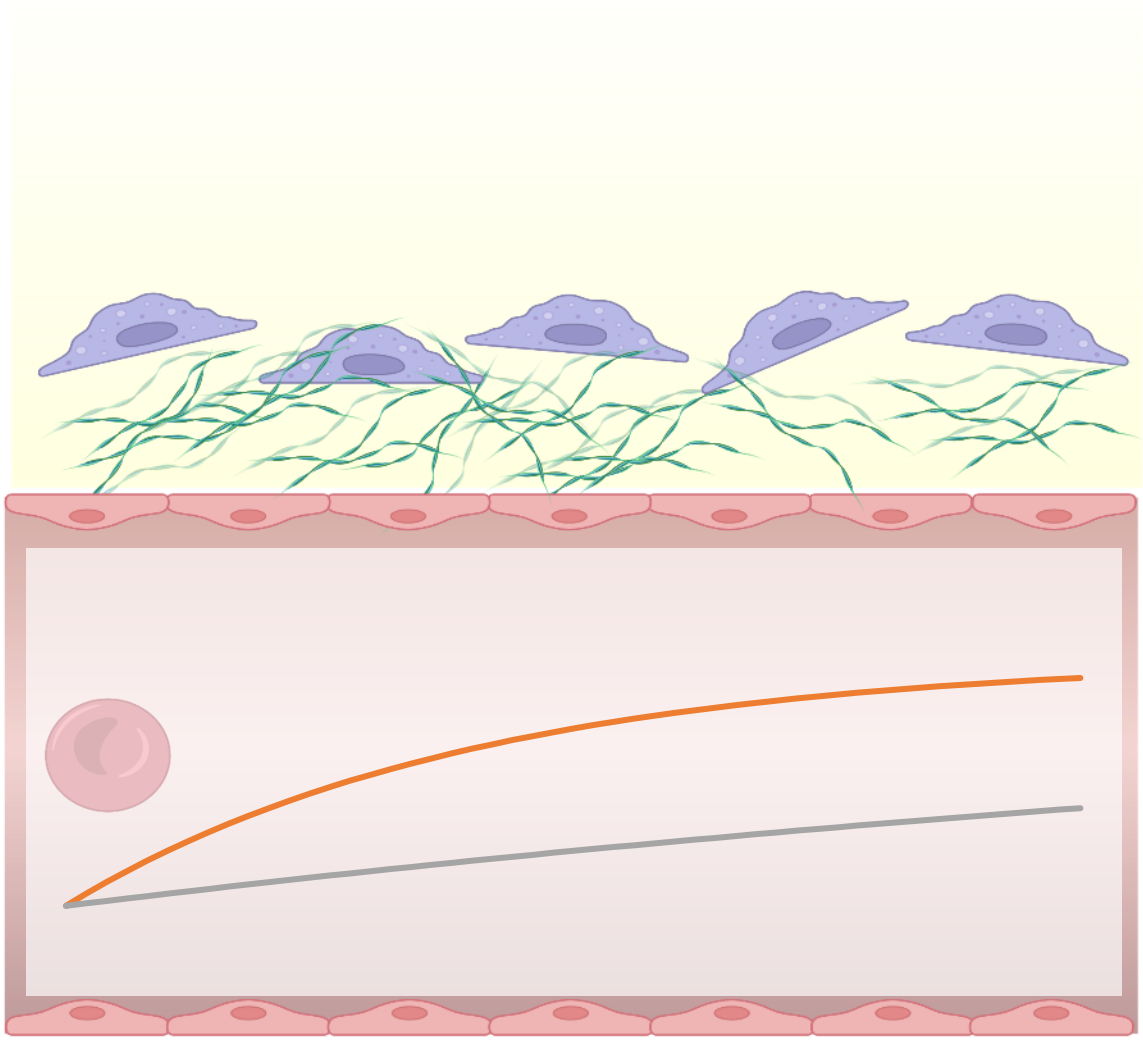


$$PiO2 = (Patm-Pb) \times FiO2 + 1.25 \times PaCO2$$

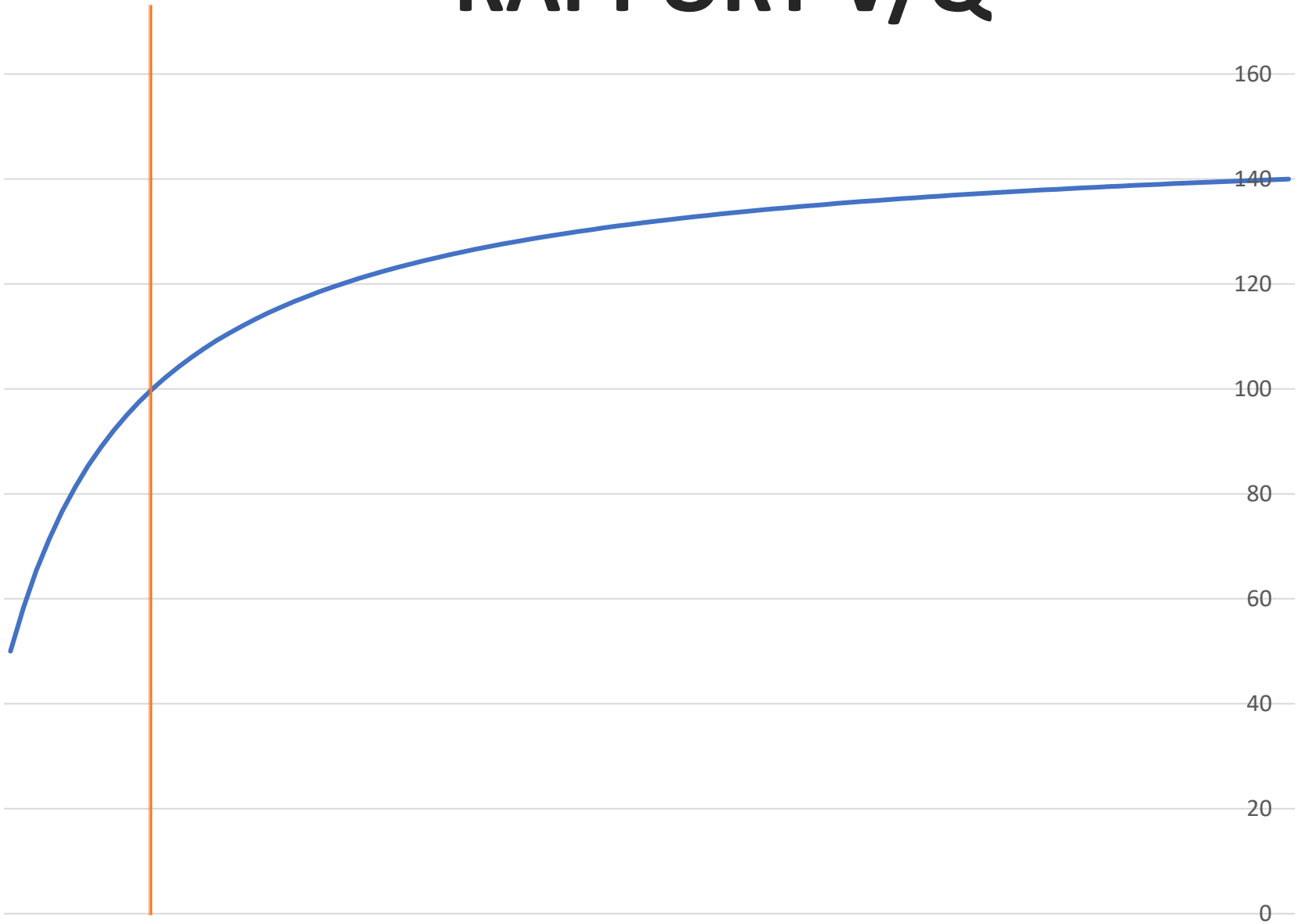
DIFFUSION





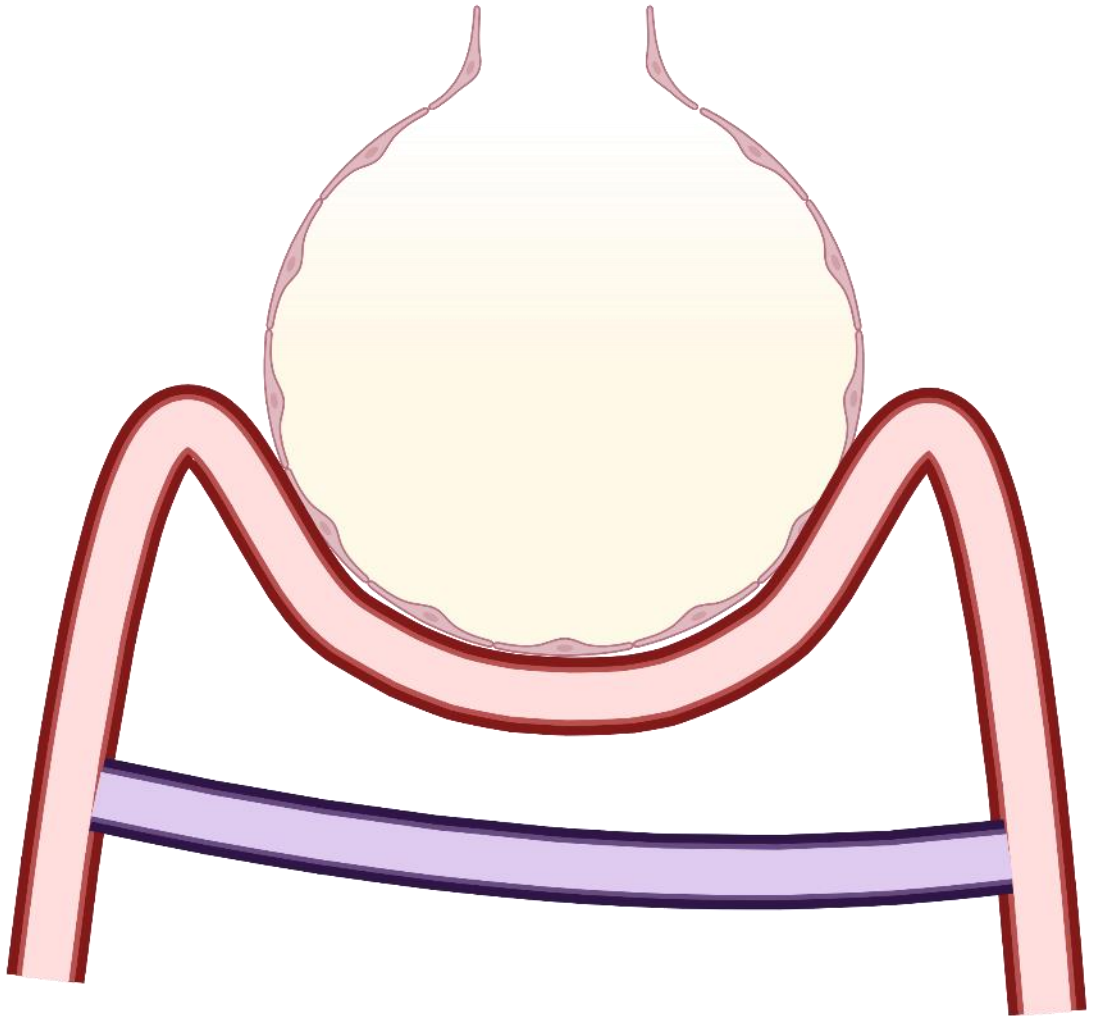
For geeks : $C_{aO2} = C_{iO2} + (C_{vO2} - C_{aO2})e^{-Dt}$

RAPPORT V/Q



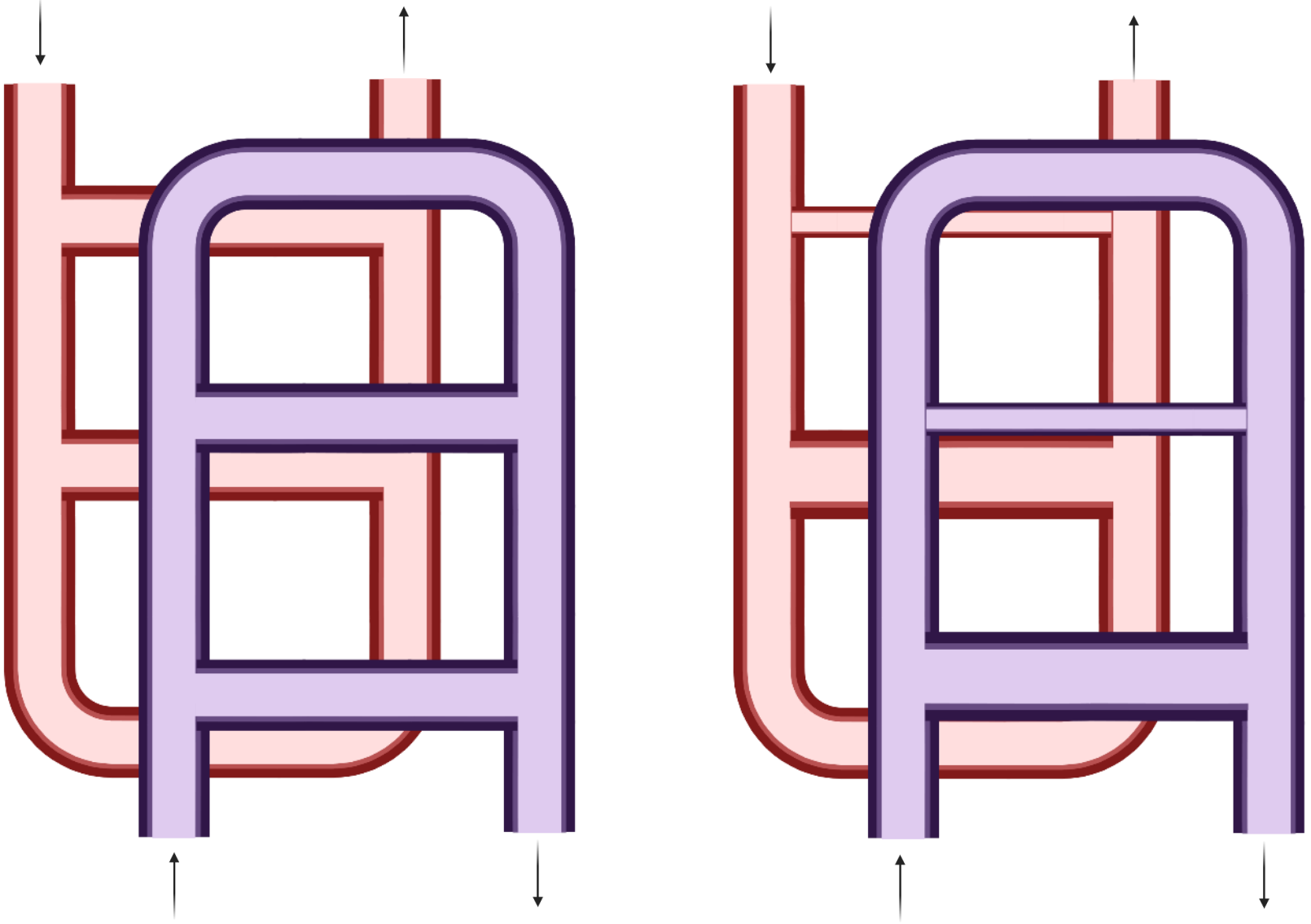
For geeks : $C_{aO2} = \frac{V}{V+Q} C_{iO2} + \frac{Q}{V+Q} C_{vO2}$

SHUNT



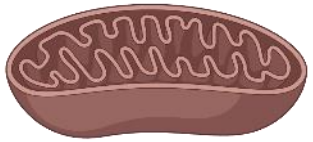
For geeks : $C_{aO2} = \frac{Q_S}{Q_T} C_{vO2} + \frac{Q_T - Q_S}{Q_T} C_{iO2}$

MISMATCH V/Q

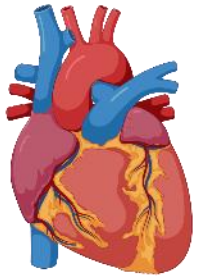


For geeks : $C_{aO2tot} = \sum \frac{Q_i}{Q} C_{aO2i} = \sum \left[\frac{Q_i}{Q} \left(\frac{V_i}{V_i + Q_i} C_{iO2} + \frac{Q_i}{V_i + Q_i} C_{vO2} \right) \right]$

CONSEQUENCES DE L'HYPOXIE

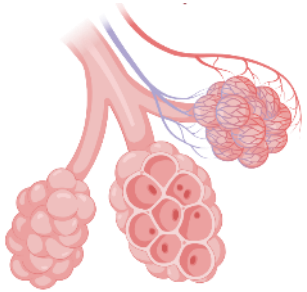


ANAEROBIE → O → RADICAUX LIBRES



NECROSE → O → VASOCONSTRICTION

VASODILATATION
NECROSE → O → INFLAMMATION
ISCHEMIE-REPERFUSION



VASOCONSTRICTION → O → SHUNT, HYPERCAPNIE

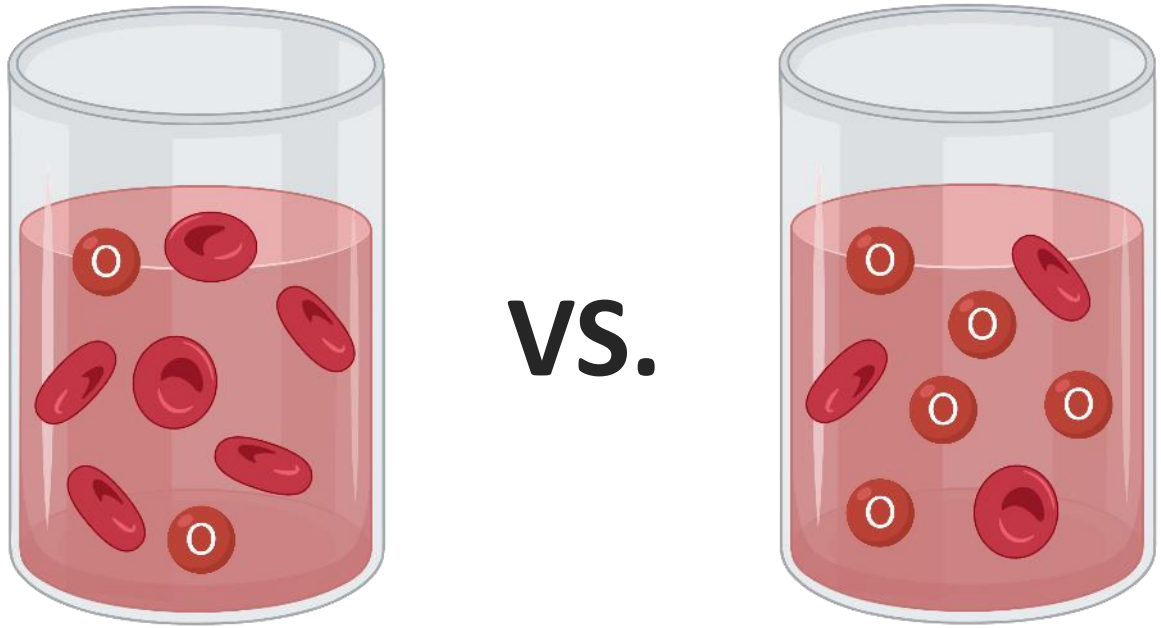
Maximal exercise at extreme altitude results in profound arterial hypoxemia and, presumably, extreme tissue hypoxia. The best evidence available indicates that the resting arterial PO2 on the summit of Mount Everest is about 28 torr and that it falls even further during exercise. Nevertheless, some 10 climbers have now reached the summit without supplementary oxygen. Paradoxically, blood lactate for a given work rate at high altitude in acclimatized subjects is essentially the same as at sea level.

≠

Altitude (m)	Barometric pressure (mmHg)	Inspired P_{O_2} (mmHg)	Alveolar P_{O_2} (mmHg)	Arterial			
				P_{O_2} (mmHg)	P_{CO_2} (mmHg)	pH	Sa_{O_2}
8848 (summit)	253	43	35	28	7.5	>7.7	70
Sea level	760	149	100	95	40	7.4	97

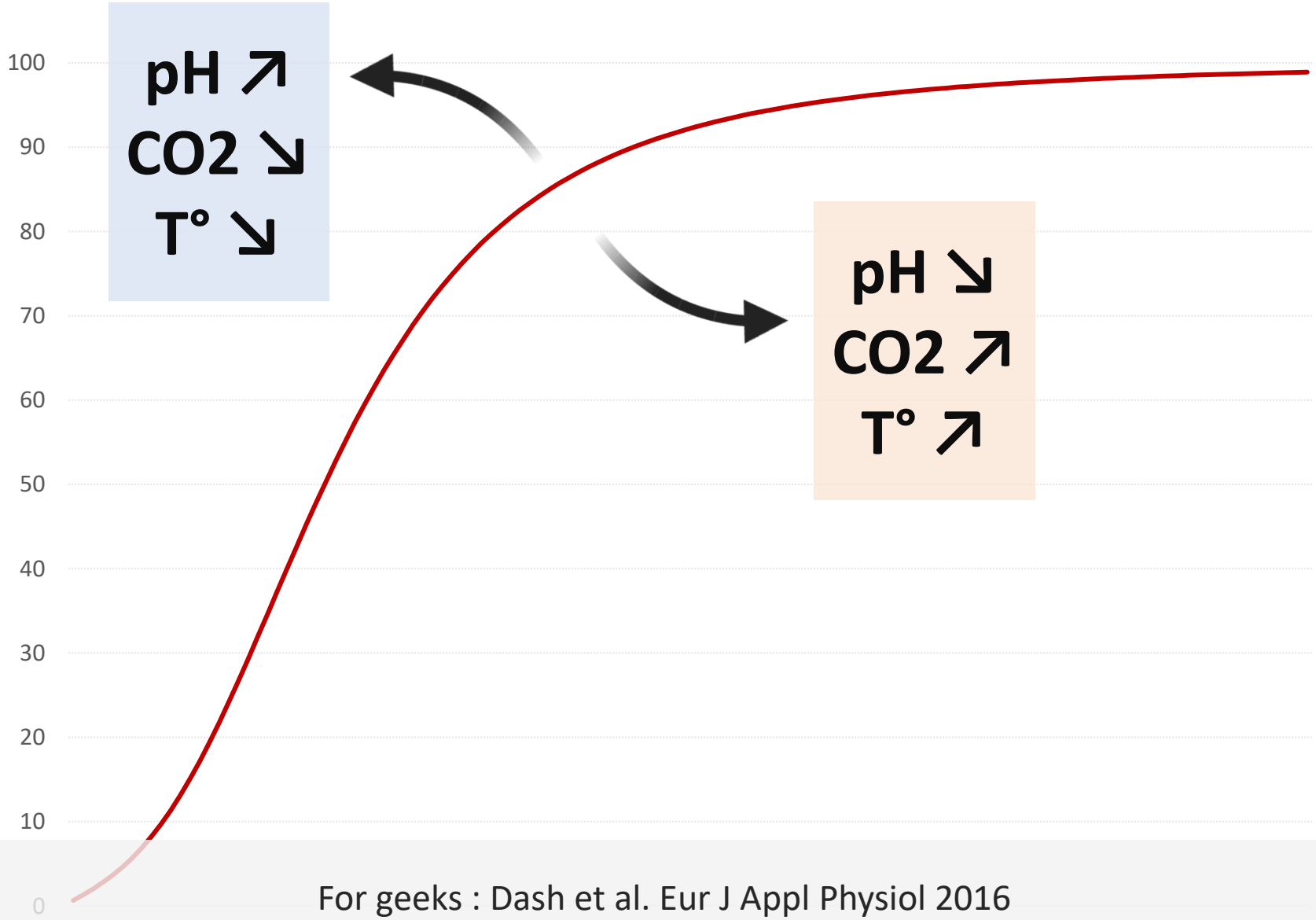
West et al., 1983b.

O2-HB OU DISSOUTE ?



VS.

EFFETS HALDANE ET BOHR



For geeks : Dash et al. Eur J Appl Physiol 2016

OBJECTIFS D'OXYGENATION

ACR, intoxication CO

Pas de facteur de risque

Facteur de risque

Facteurs de risque :

BPCO, obésité morbide, fibrose kystique, déformation thoracique, pathologie neuromusculaire, insuffisance respiratoire obstructive fixée

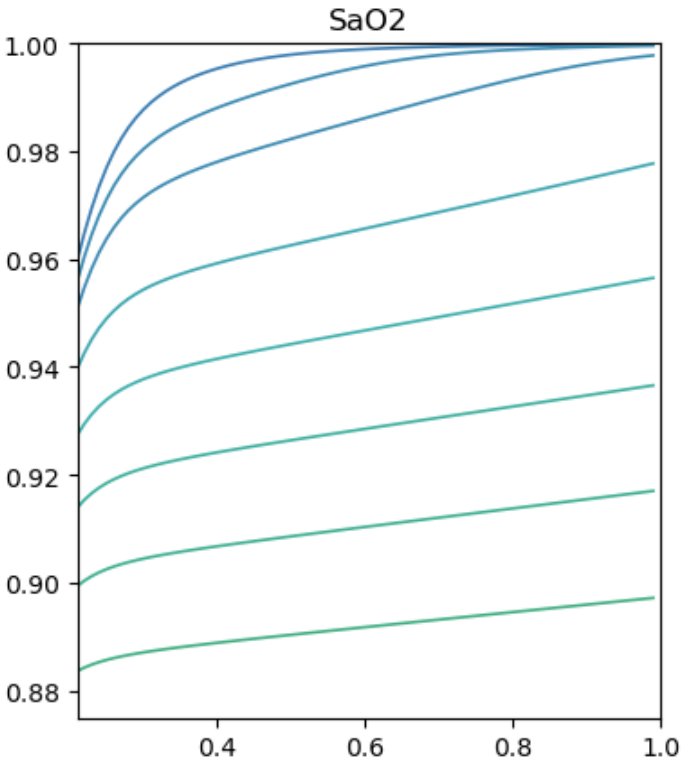
INDICES D'OXYGENATION

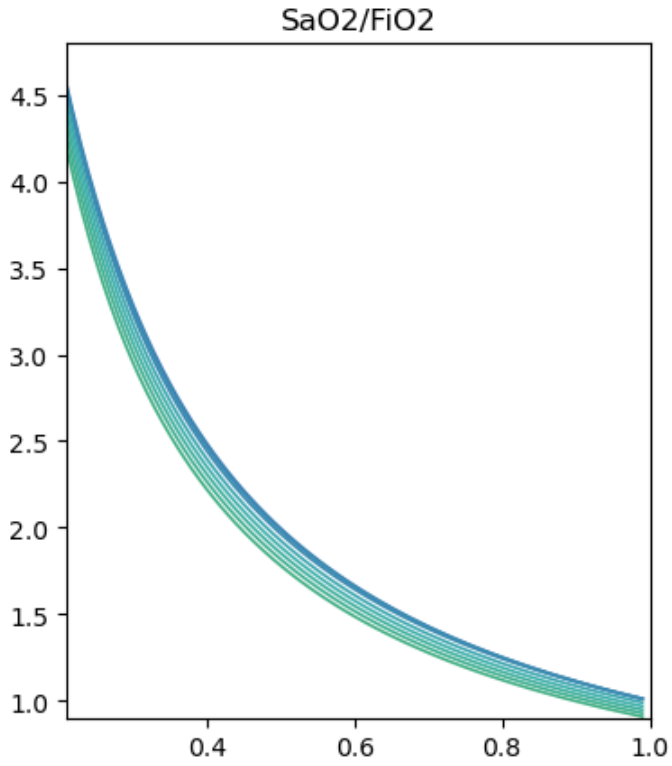
PaO2/FiO2

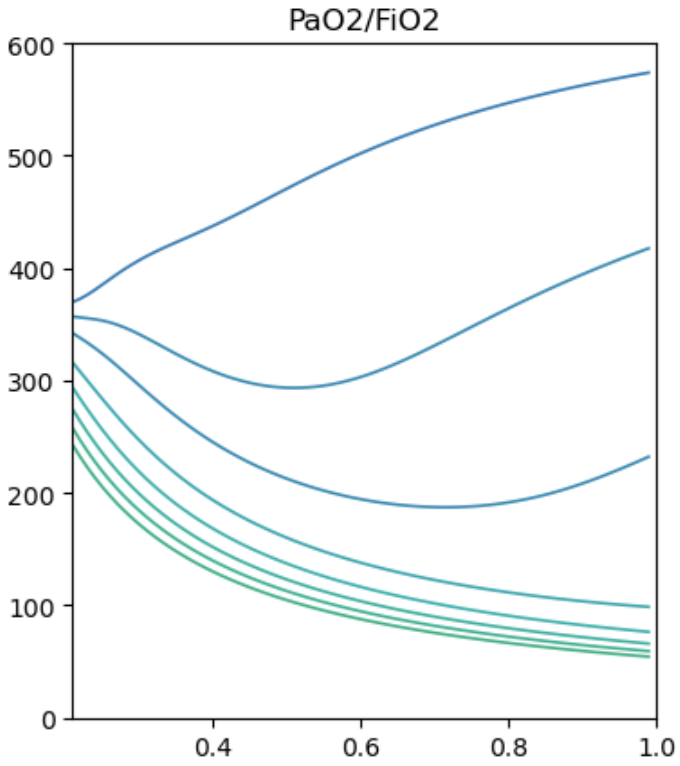
SpO2/FiO2

A-a gradient

PaO2/FiO2

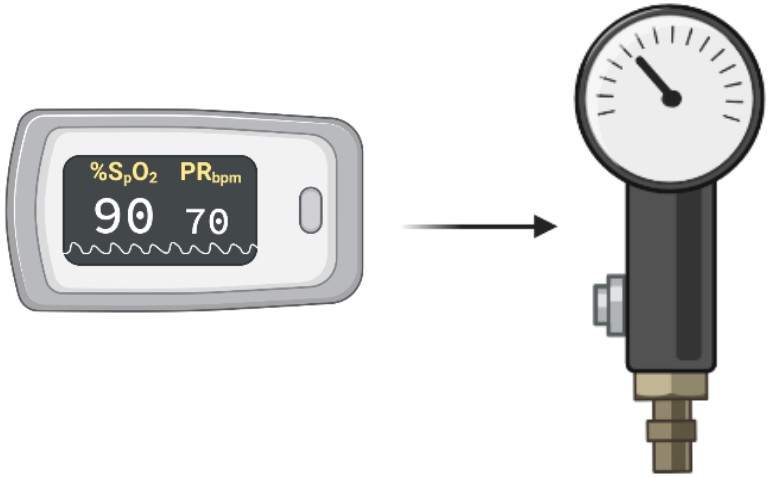






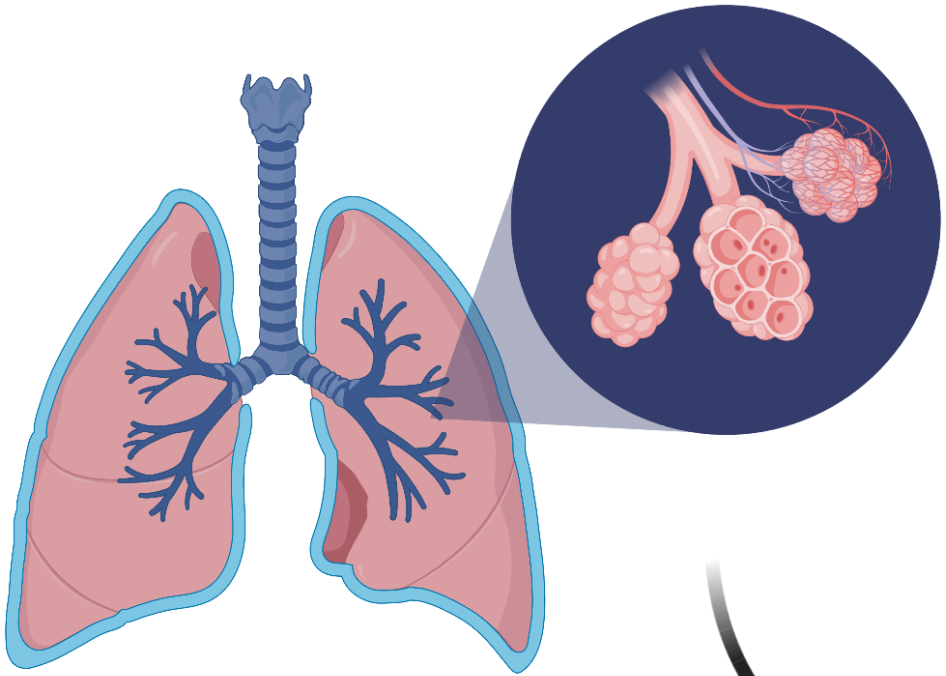
Personal data, manuscript in progress

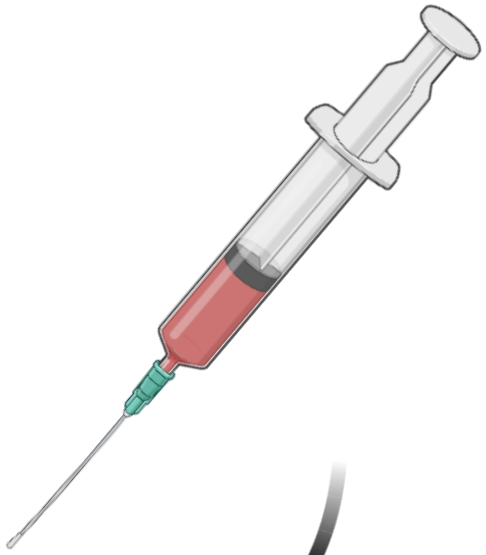
SpO2/FiO2



SpO2/FiO2	PaO2/FiO2
470	400
320	300
235	200

A-a gradient





$$\Delta_{A-aO2} = P_{iO2} - P_{aO2}$$ (norme < 20)

$$P_{iO2} - P_{aO2} > 20$$

$$(760 - 47) \times 0.21 - 1.25P_{aCO2} - P_{aO2} > 20$$

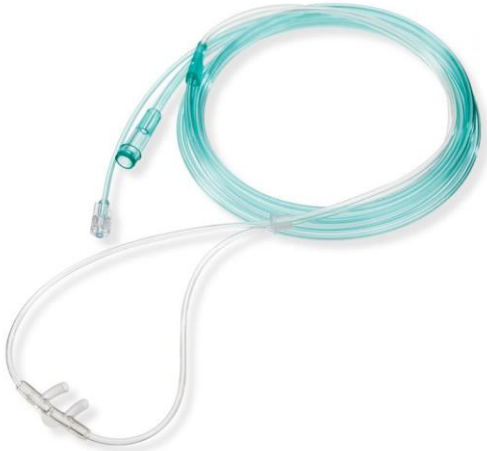
$$150 - 1.25P_{aCO2} - P_{aO2} > 20$$

$$150 - P_{aCO2} - 0.25P_{aCO2} - P_{aO2} > 20$$

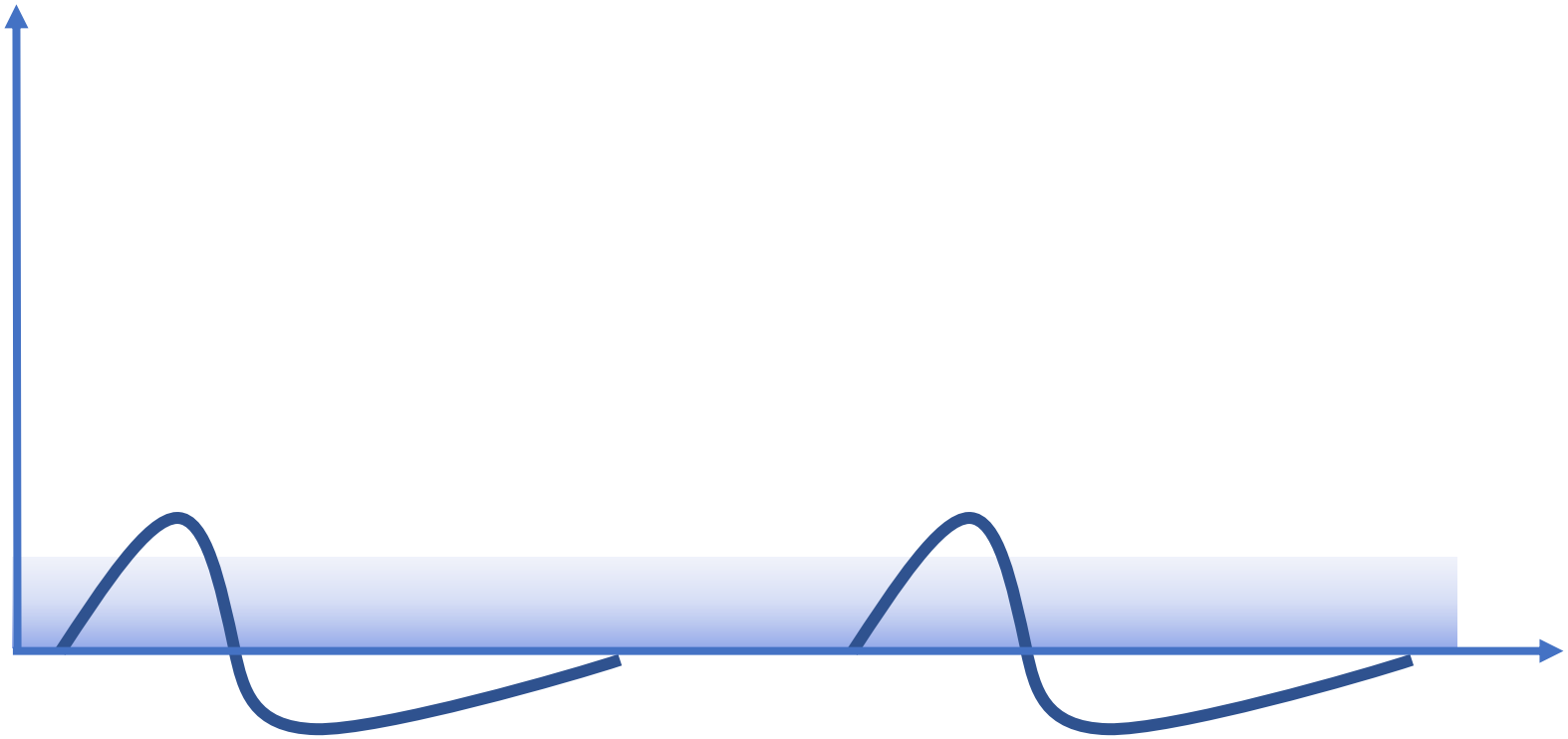
$$150 - P_{aCO2} - 10 - P_{aO2} > 20$$

$$P_{aO2} + P_{aCO2} < 150 - 20 - 10 = 120$$

VECTEURS D’OXYGENE

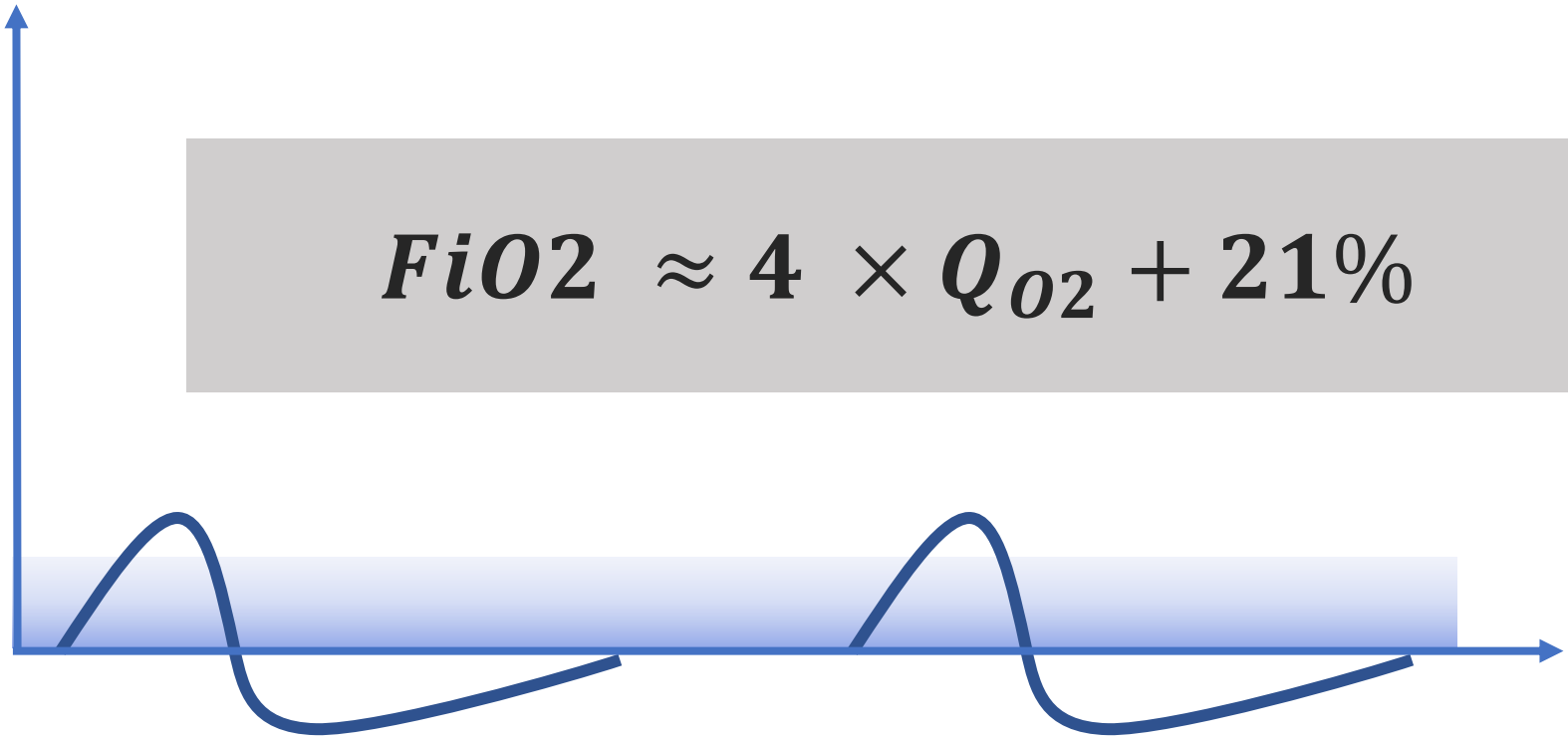


EVOLUTION DE LA FiO2



EVOLUTION DE LA FiO2

$$FiO2 \approx 4 \times Q_{O2} + 21\%$$

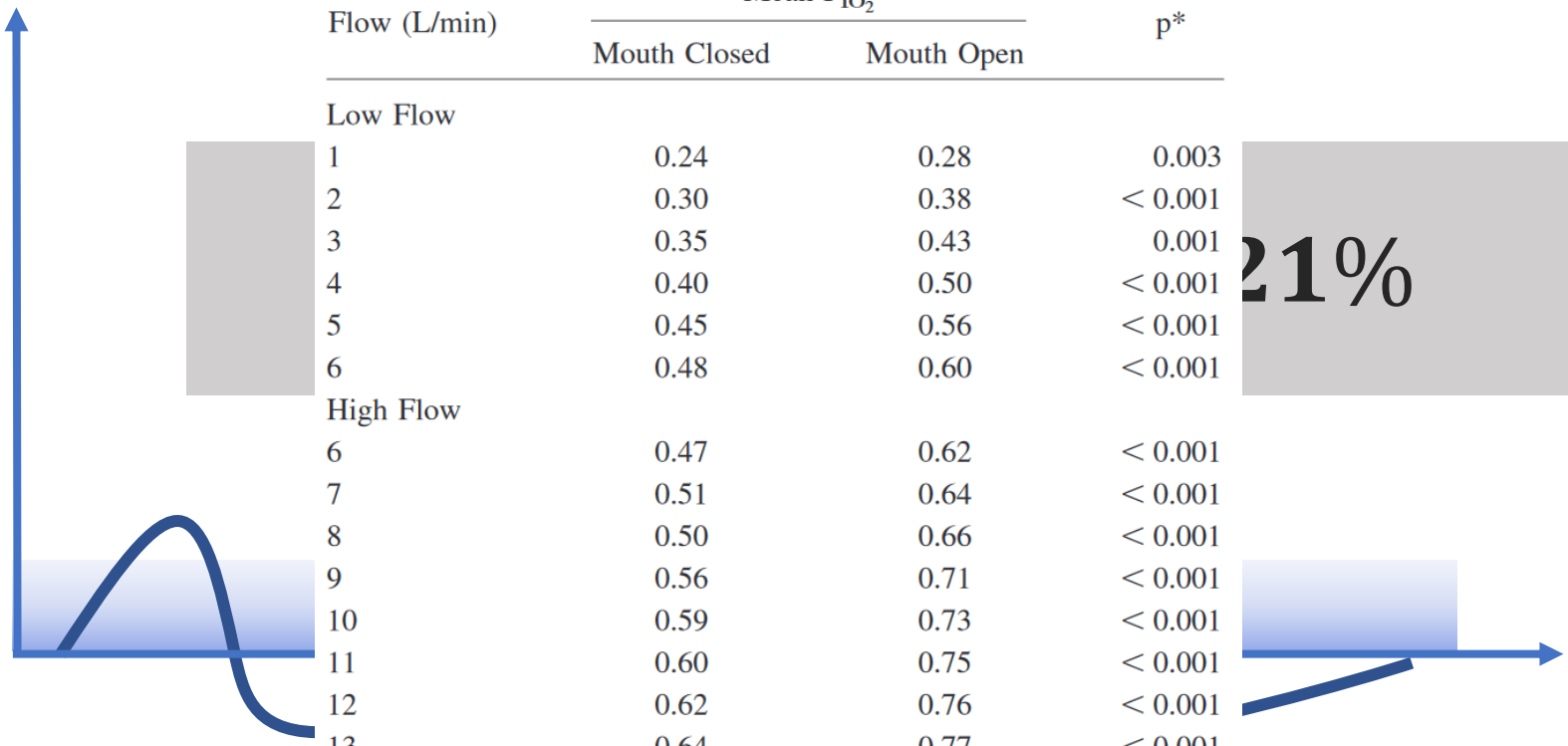


EVOLUTION DE LA FiO2

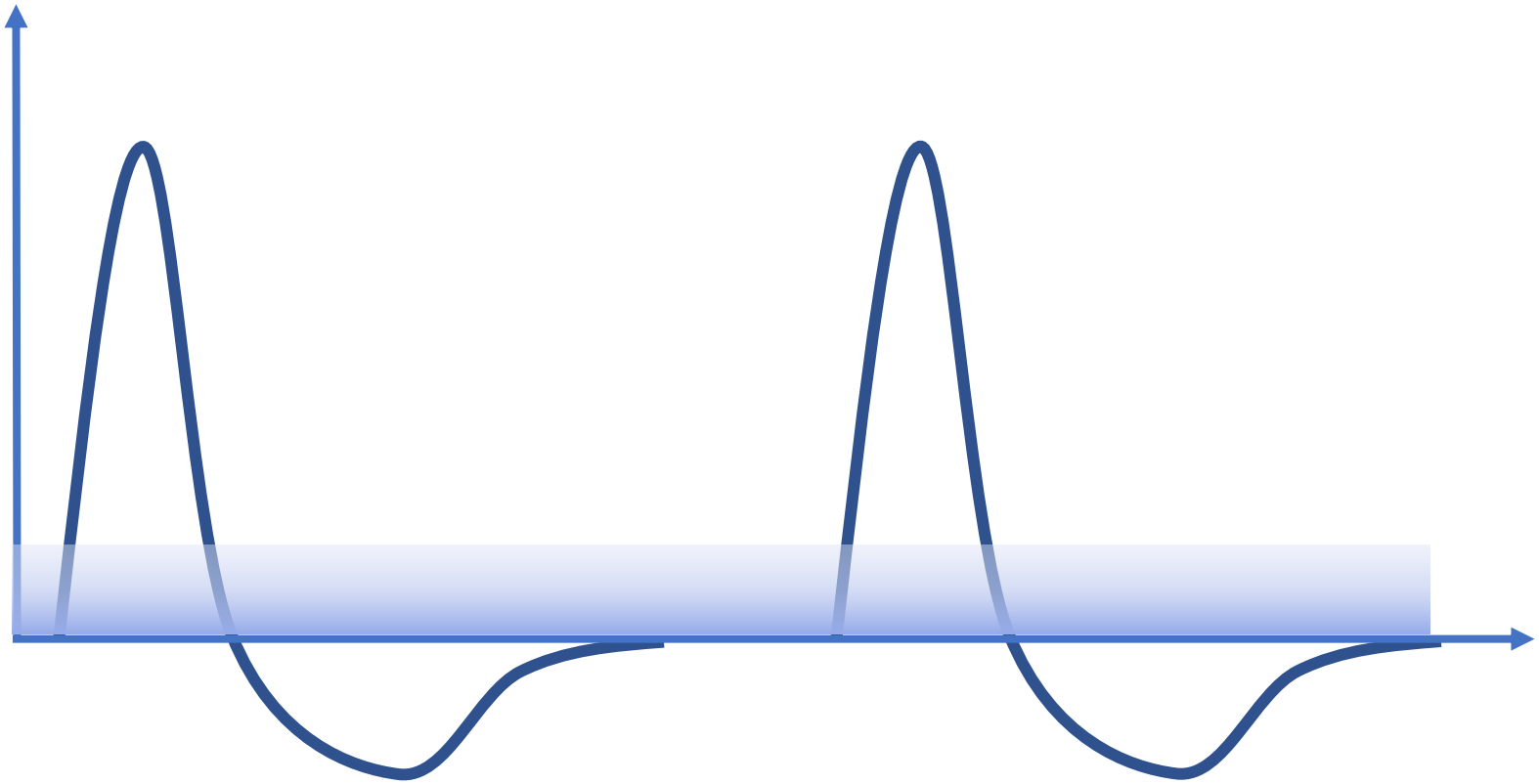
Table 1. F_{IO_2} During Mouth-Closed and Mouth-Open Breathing

Flow (L/min)	Mean F_{IO_2}		p*
	Mouth Closed	Mouth Open	
Low Flow			
1	0.24	0.28	0.003
2	0.30	0.38	< 0.001
3	0.35	0.43	0.001
4	0.40	0.50	< 0.001
5	0.45	0.56	< 0.001
6	0.48	0.60	< 0.001
High Flow			
6	0.47	0.62	< 0.001
7	0.51	0.64	< 0.001
8	0.50	0.66	< 0.001
9	0.56	0.71	< 0.001
10	0.59	0.73	< 0.001
11	0.60	0.75	< 0.001
12	0.62	0.76	< 0.001
13	0.64	0.77	< 0.001
14	0.68	0.79	< 0.001
15	0.70	0.81	0.001

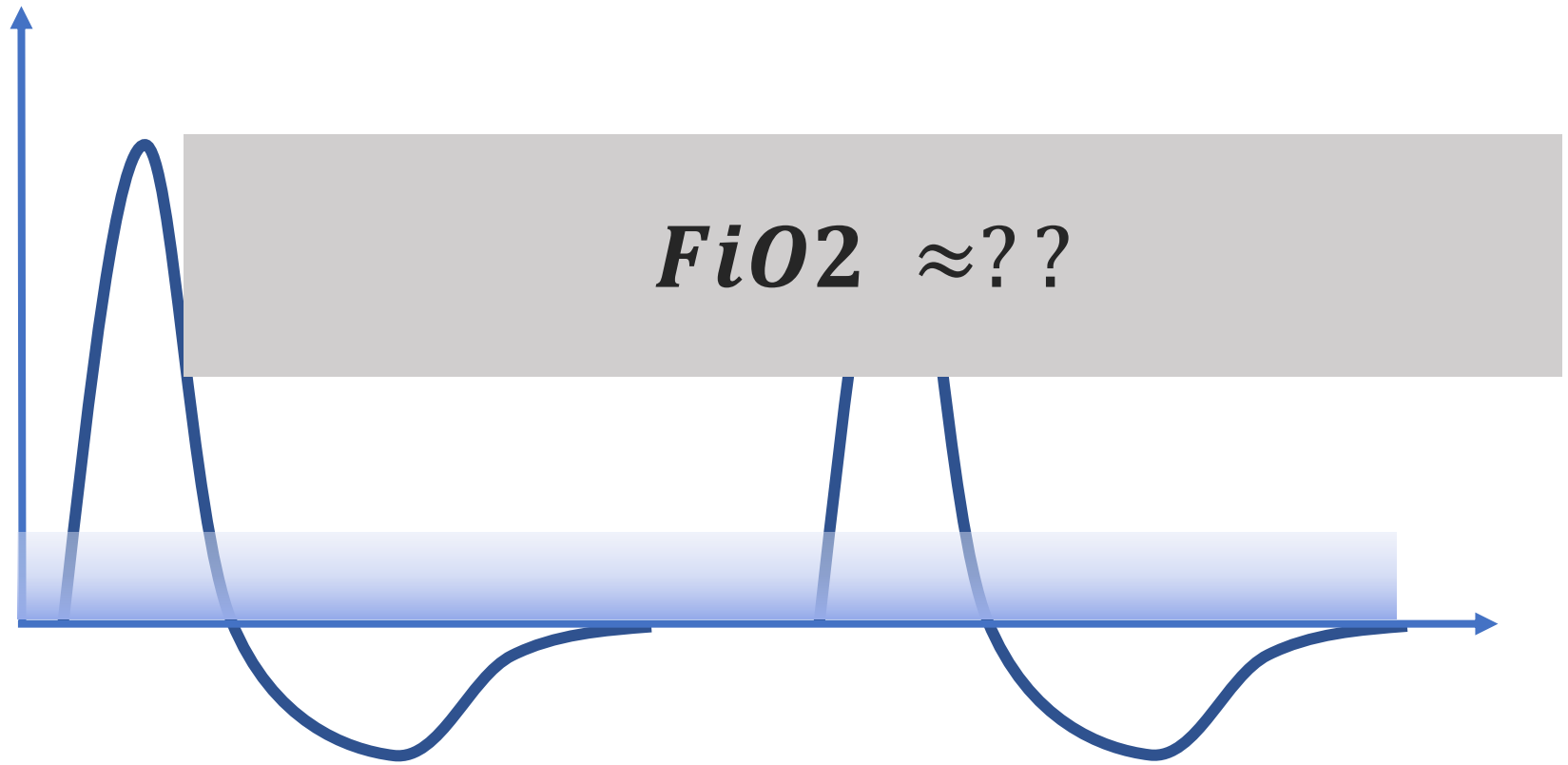
F_{IO_2} = fraction of inspired oxygen
*All values were significant ($p > 0.003$)



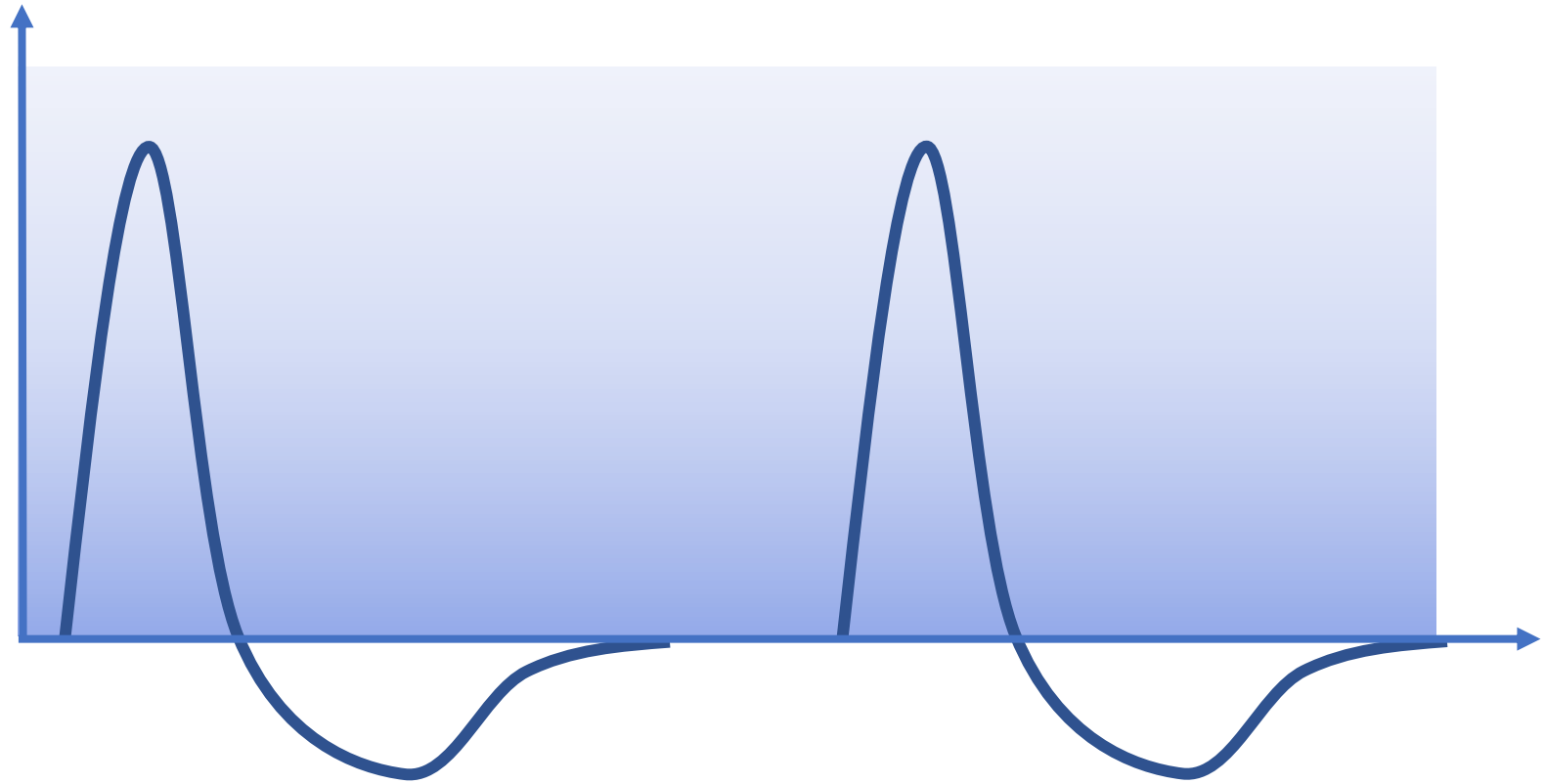
EVOLUTION DE LA FiO2



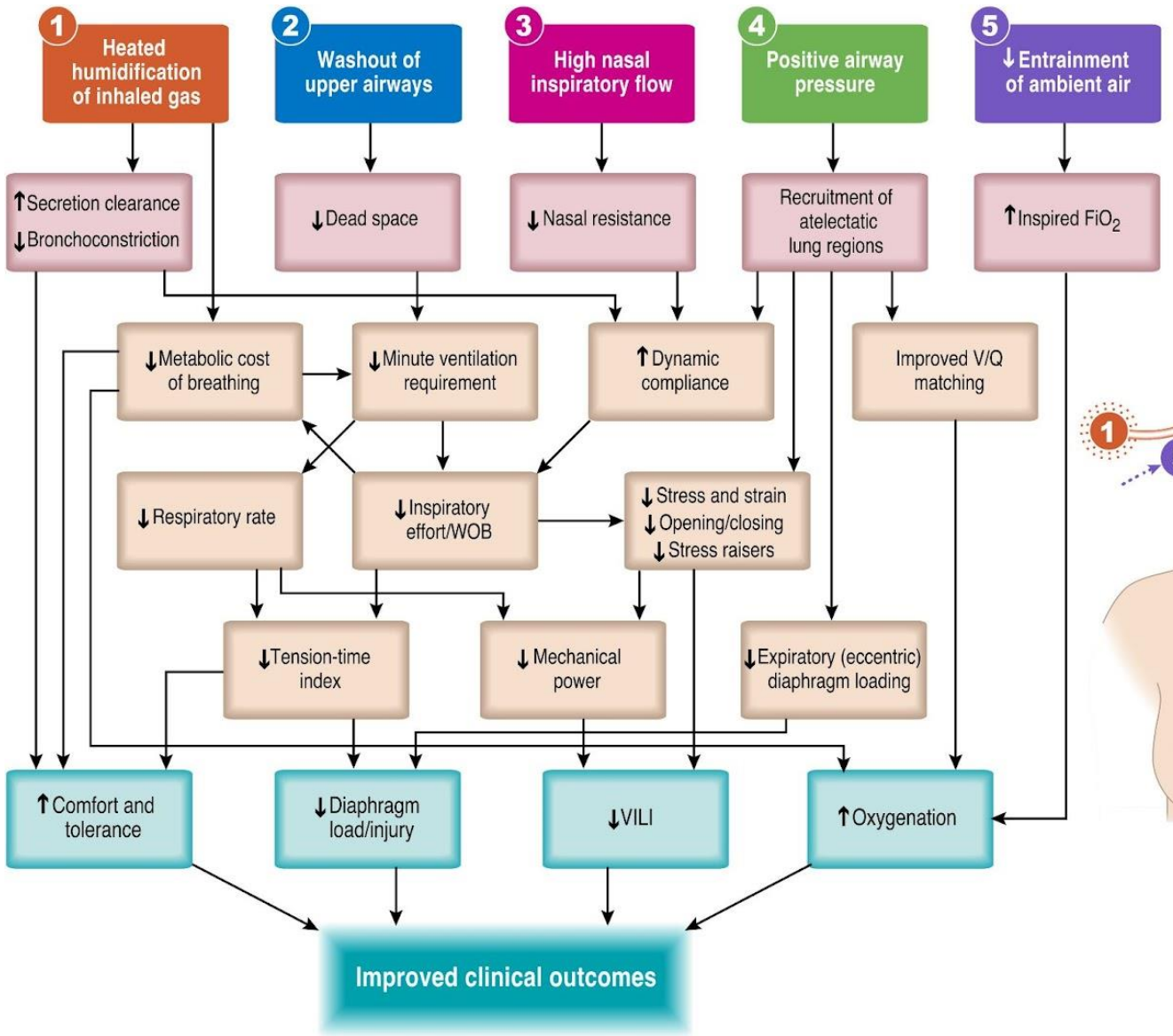
EVOLUTION DE LA FiO2

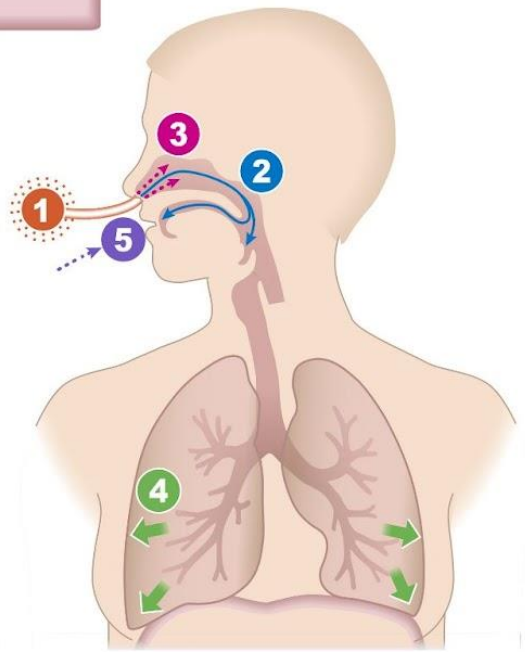


PRINCIPE DE L'OHD



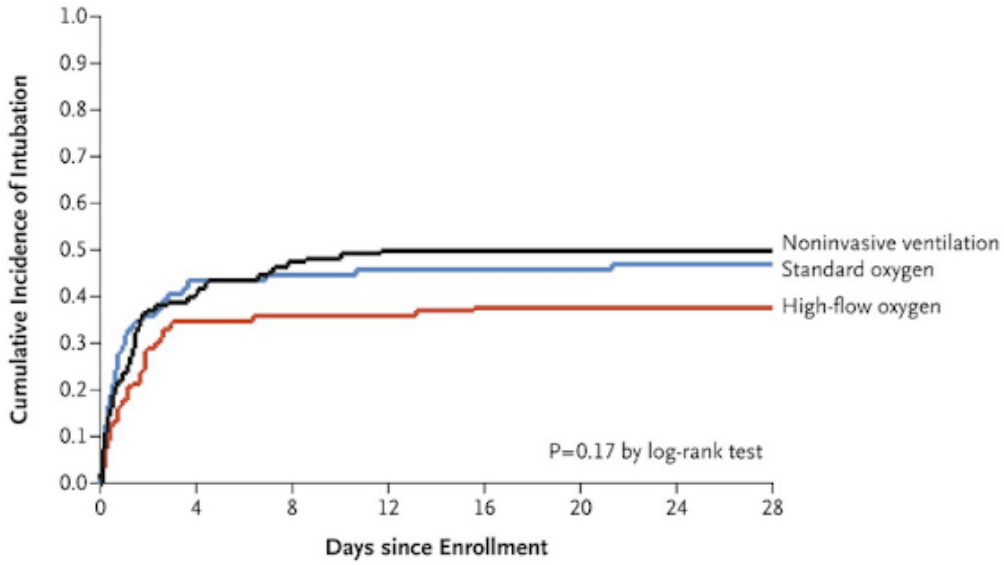
PRINCIPE DE L'OHD



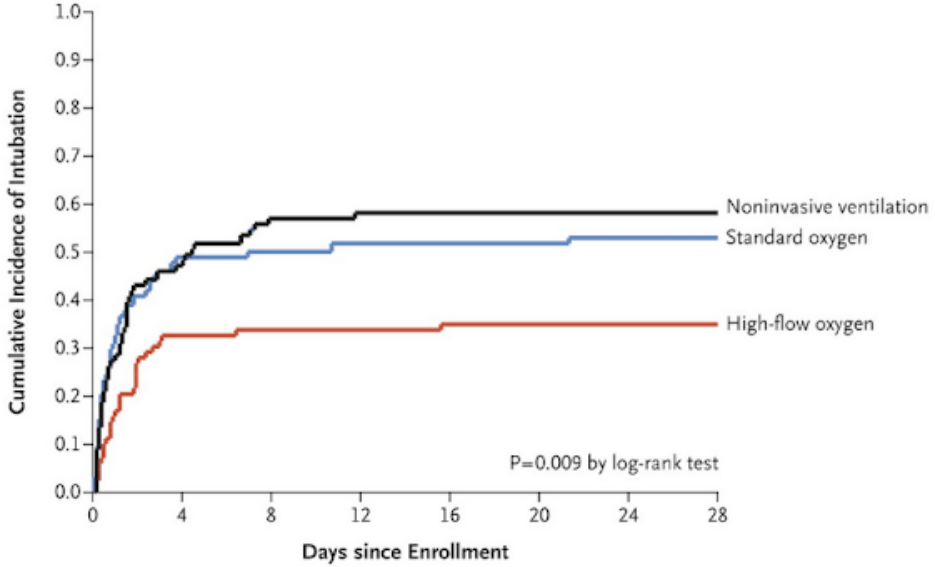


PRINCIPE DE L'OHD

Overall Population

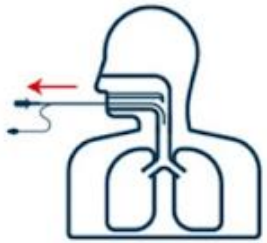
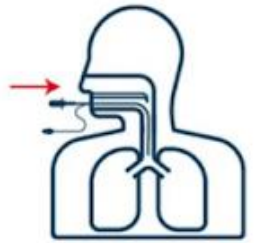


Patients with a PaO_2:FIO_2 ≤200 mm Hg



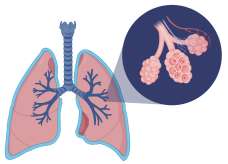
GUIDELINES ESICM

When should high flow nasal cannula (HFNC) be used in the clinical setting?

Hypoxemic respiratory failure *(moderate certainty)*	Following extubation *(moderate certainty)*	Postoperative HFNC in high risk and/or obese patients following cardiac or thoracic surgery *(moderate certainty)*	Peri-intubation period *(moderate certainty)*
			
Strong recommendation	**Conditional recommendation**	**Conditional recommendation**	**No recommendation**

TAKE HOME MESSAGES

Applications directes de la physiologie



Limiter les gazs du sang au strict nécessaire

Objectif SpO2 adapté au contexte, titration

Risques de l'hyperoxie mal connus

Indices d'oxygénation innovants

OHD aux urgences

THX !

Slides

www.pierre-catoire.science