Les moyens mécaniques diminuent-ils la dyspnée à l'exercice mieux que le reste ?

Dr Capucine Morélot-Panzini

Service de Pneumologie et Réanimation Médicale, Département R3S
Groupe Hospitalier Pitié-Salpêtrière Charles Foix

UMR_S 1158
Neurophysiologie Respiratoire Expérimentale et Clinique
Université Paris 6 Pierre et Marie Curie
Paris, France

déclaration de lien d'intérêts

- Novartis
- Astra Zeneca
- Chiesi
- Pierre Fabre Médicament
- Boehringer Ingelheim
- Breas
- ADEP
- Homeperf

introduction - définition

Expérience subjective d'inconfort respiratoire faite de sensations qualitativement distinctes et d'intensité variable

= définition 1999, en soulignant des éléments clefs :

- **subjectivité** : dissociation "symptôme vs signes" et importance du "self-report"

- **multimodalité** : différentes sensations dyspnéiques de mécanismes distincts

- **multidimensionalité** : le "percept" [*dimension sensorielle*] doit être associé à un "affect" négatif ("unpleasantness") pour parler de dyspnée [*dimension affective*] ; les intensités sensorielle et affectives peuvent varier indépendamment

- **diffusivité** : la dyspnée a un impact neurovégétatif, émotionnel, et comportemental (*importance des notions de cognition et d'interprétation selon l'histoire personnelle et l'environnement socio-familial, par exemple*)

Parshall, AJRCCM 2012

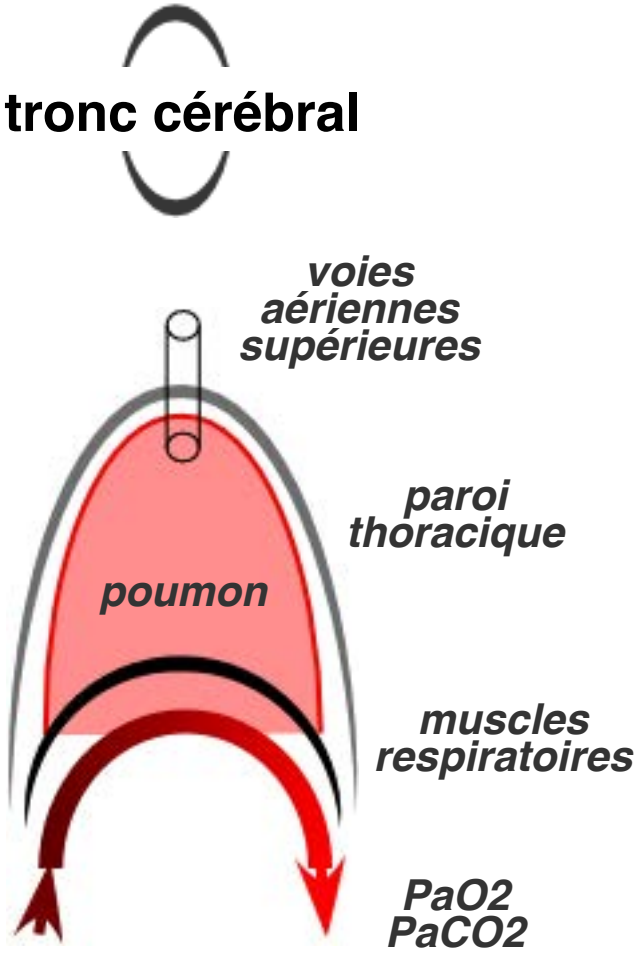
introduction – pertinence clinique

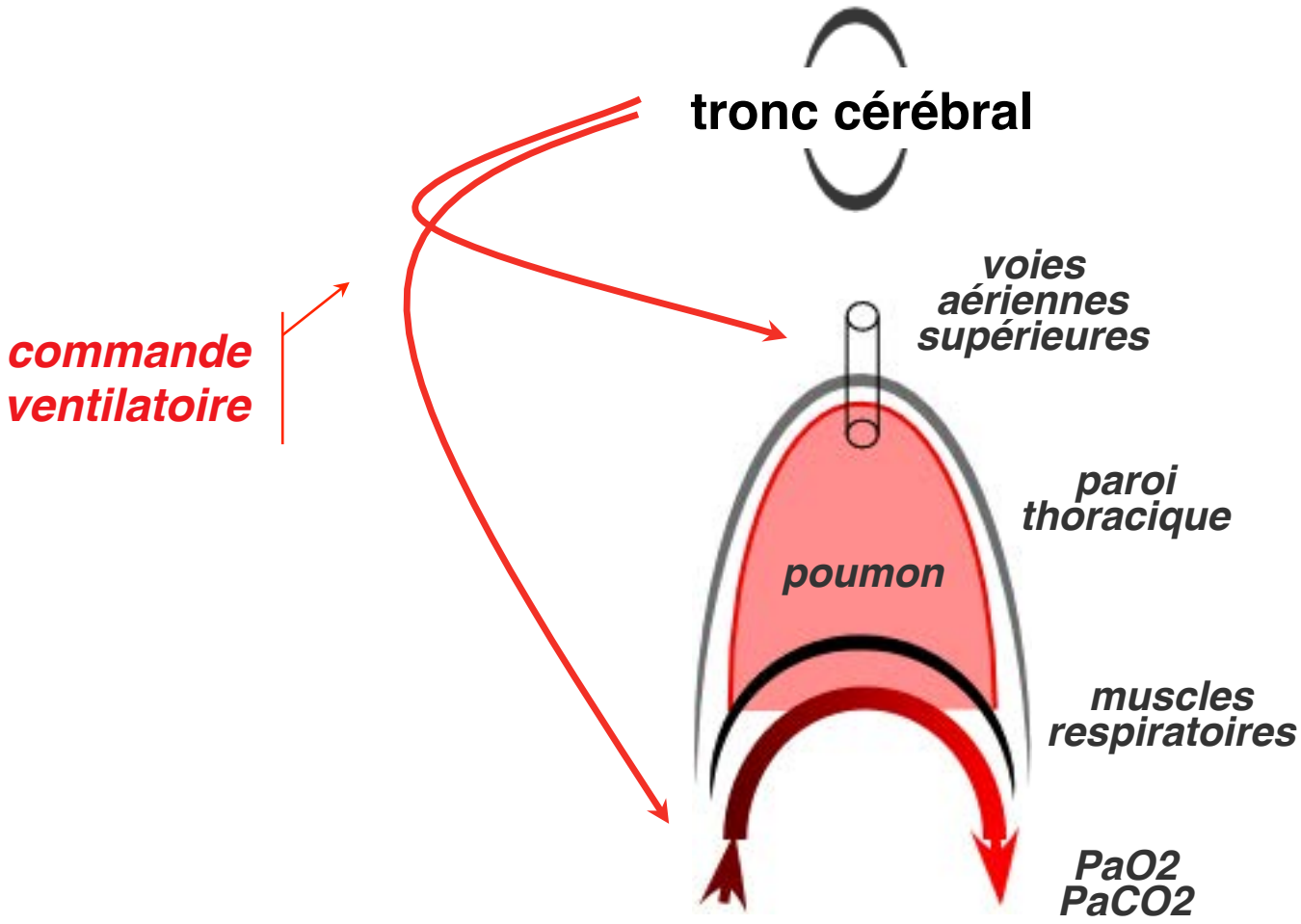
parmi les patients BPCO :

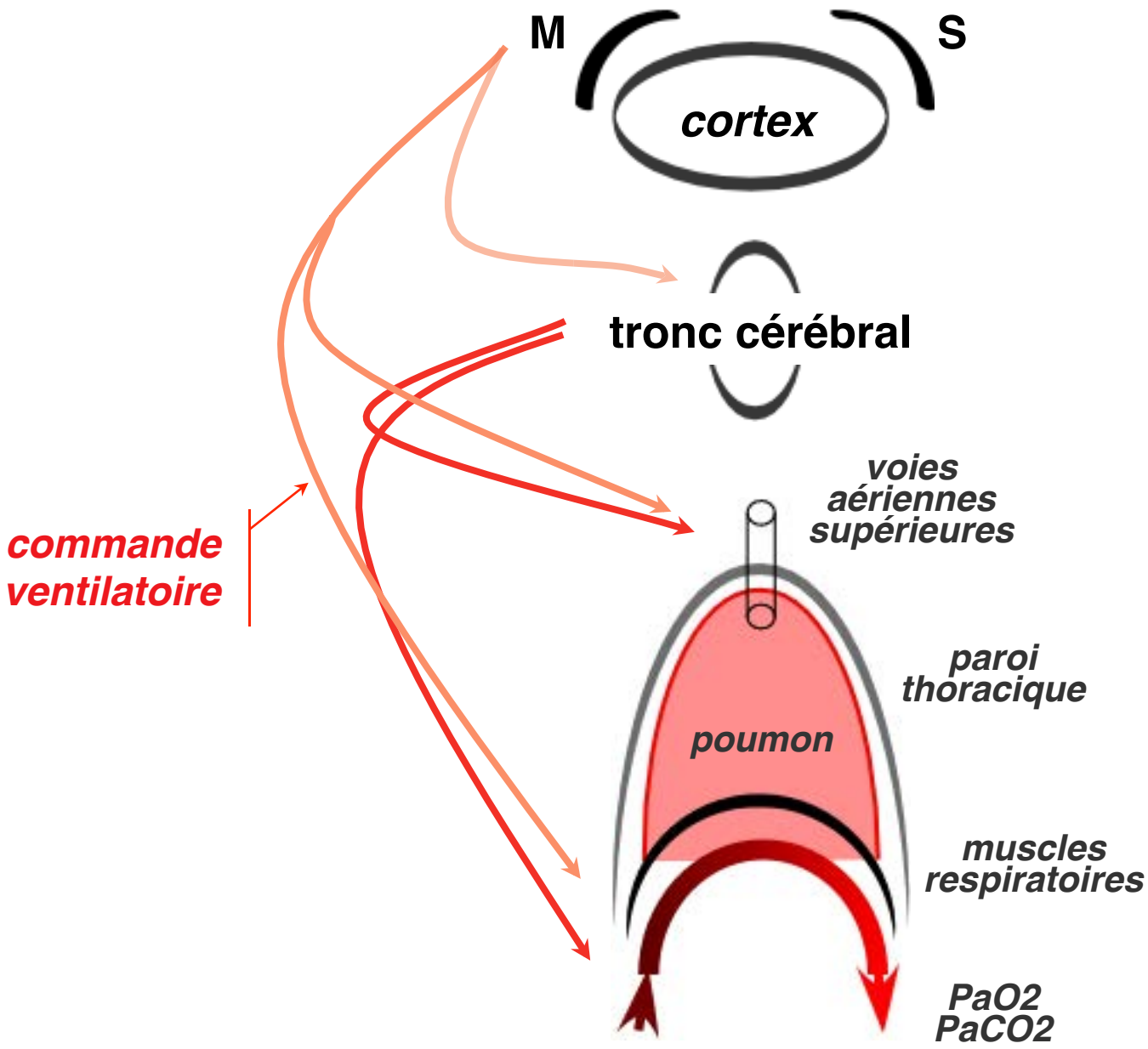
- 20 % ressentent une dyspnée au repos
- 24 % souffrent de dyspnée à la parole
- 30 % patients avec une dyspnée pour des activités quotidiennes (toilette)
- 70% patients ont une dyspnée à l'effort (montée de quelques marches)

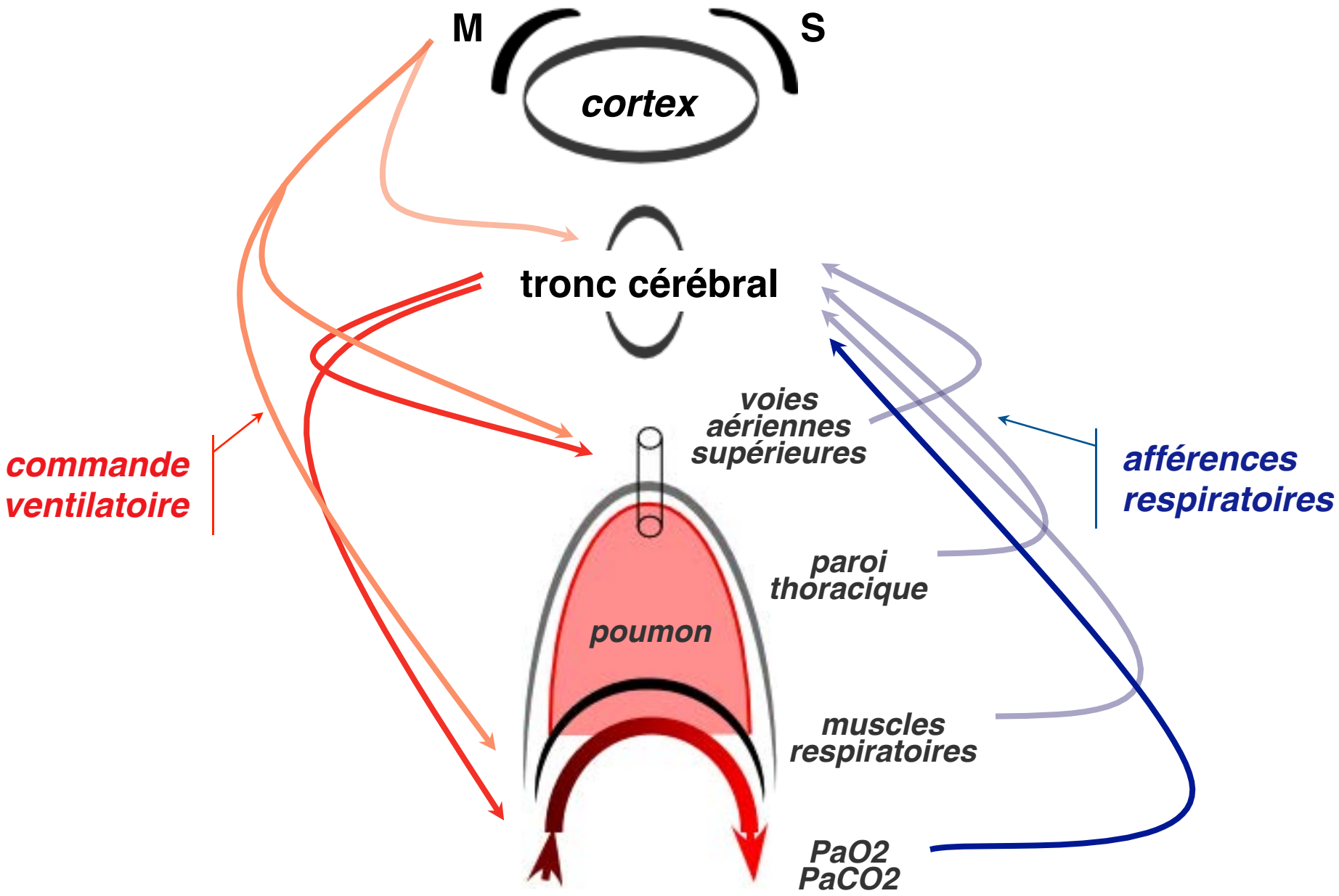
Rennard, Eur Respir J, 2002

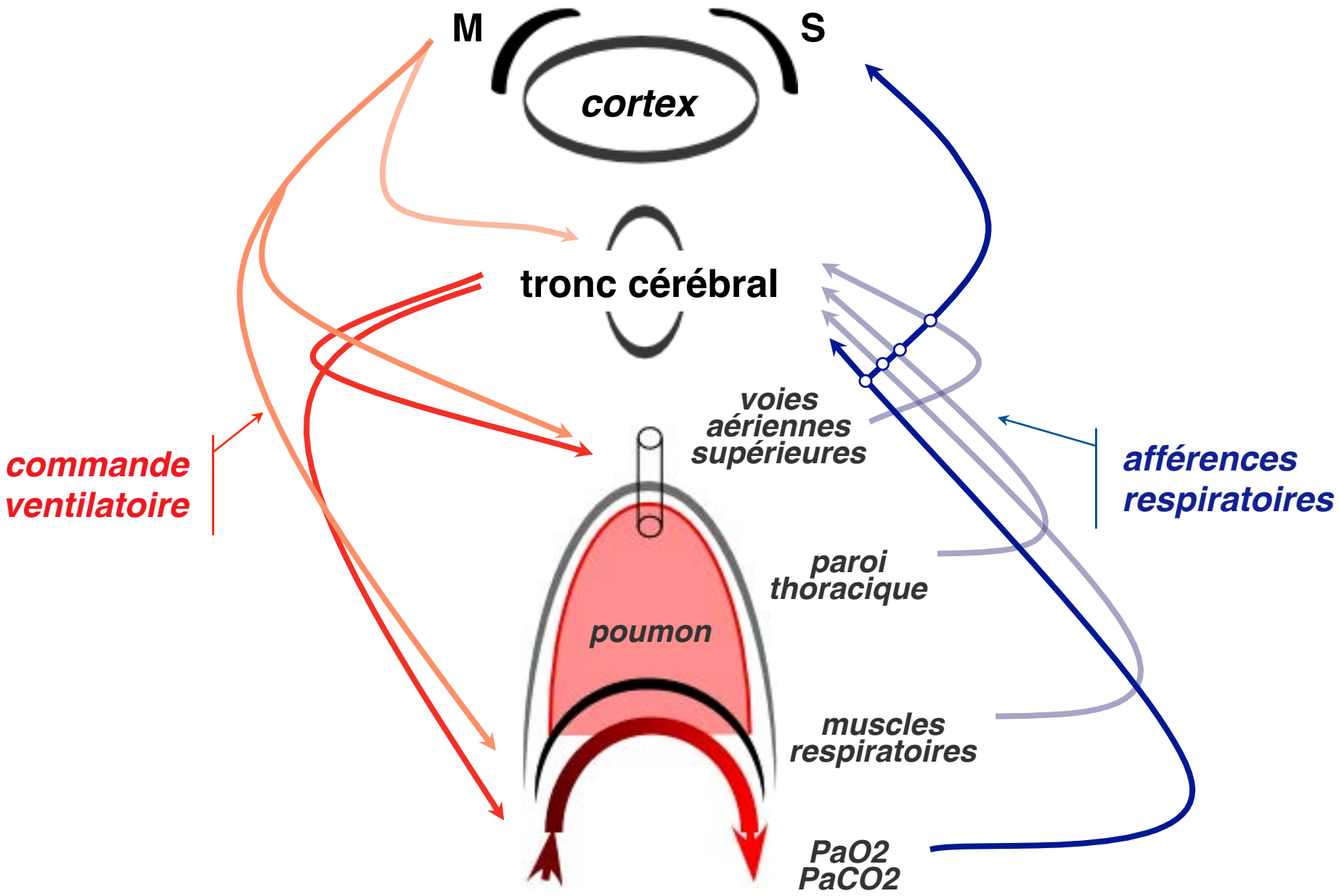
physiopathologie

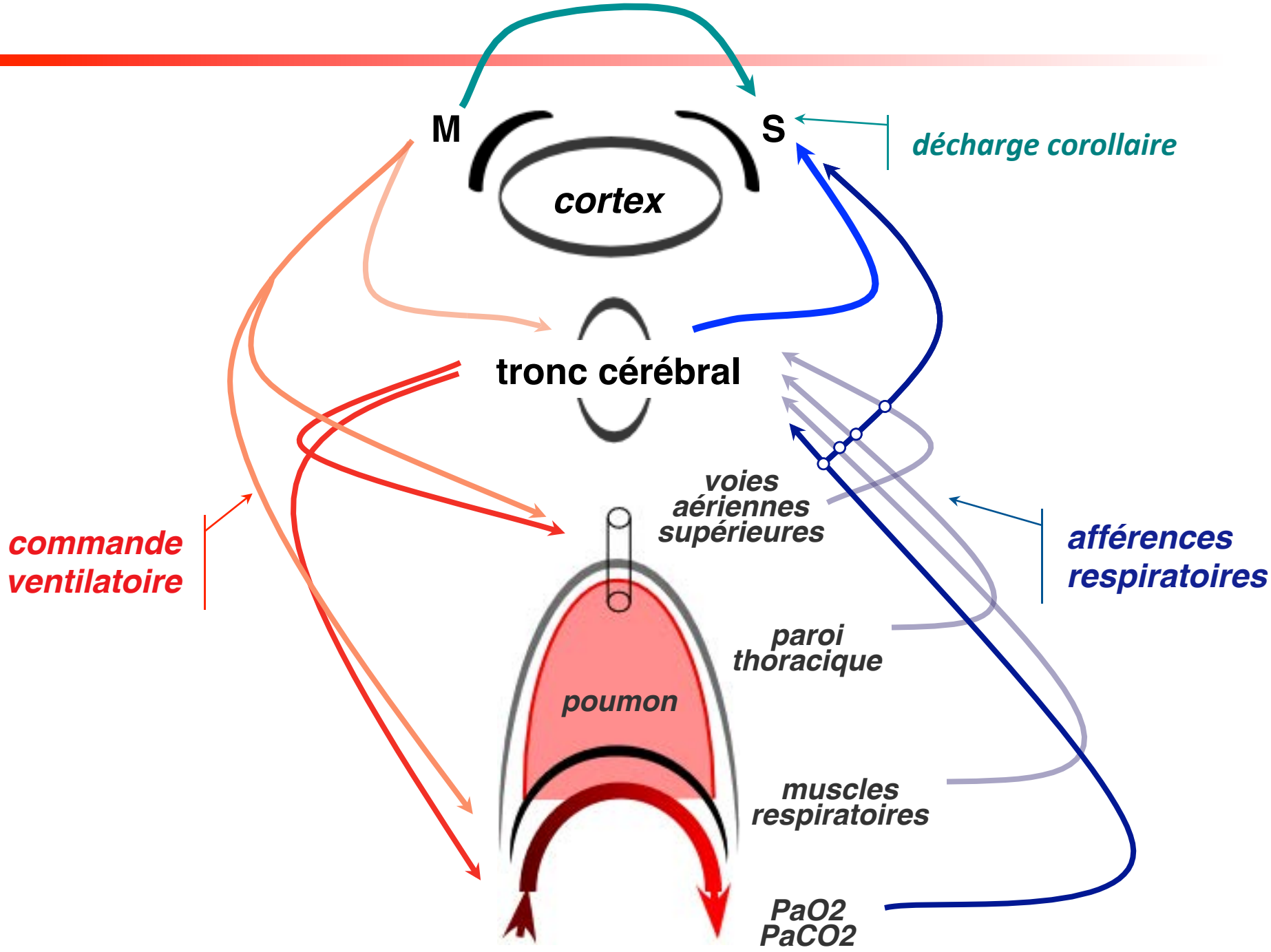

tronc cérébral
voies aériennes supérieures
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2

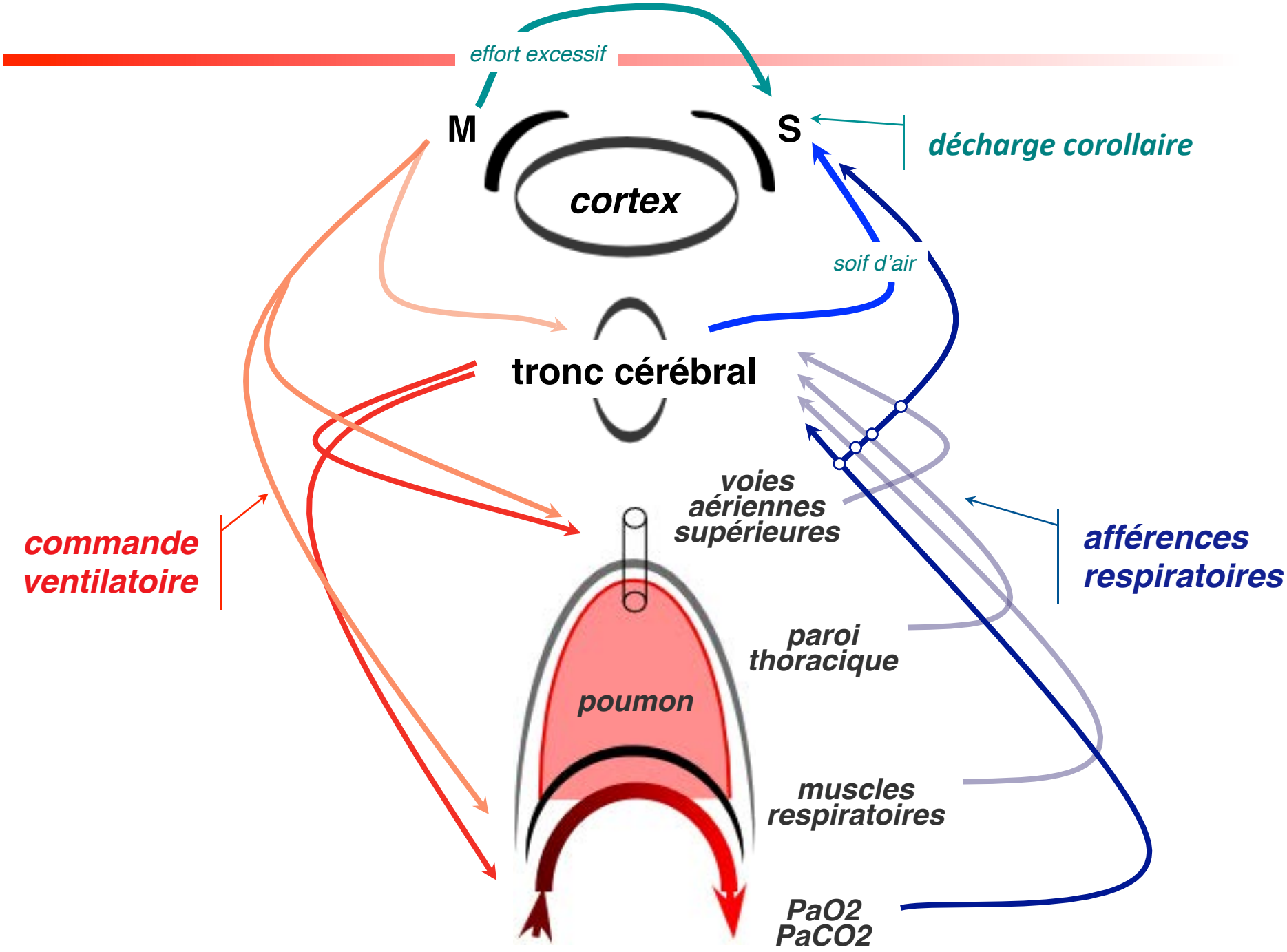

tronc cérébral
commande ventilatoire
voies aériennes supérieures
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2


M
S
cortex
tronc cérébral
commande
ventilatoire
voies
aériennes
supérieures
paroi
thoracique
poumon
muscles
respiratoires
PaO2
PaCO2

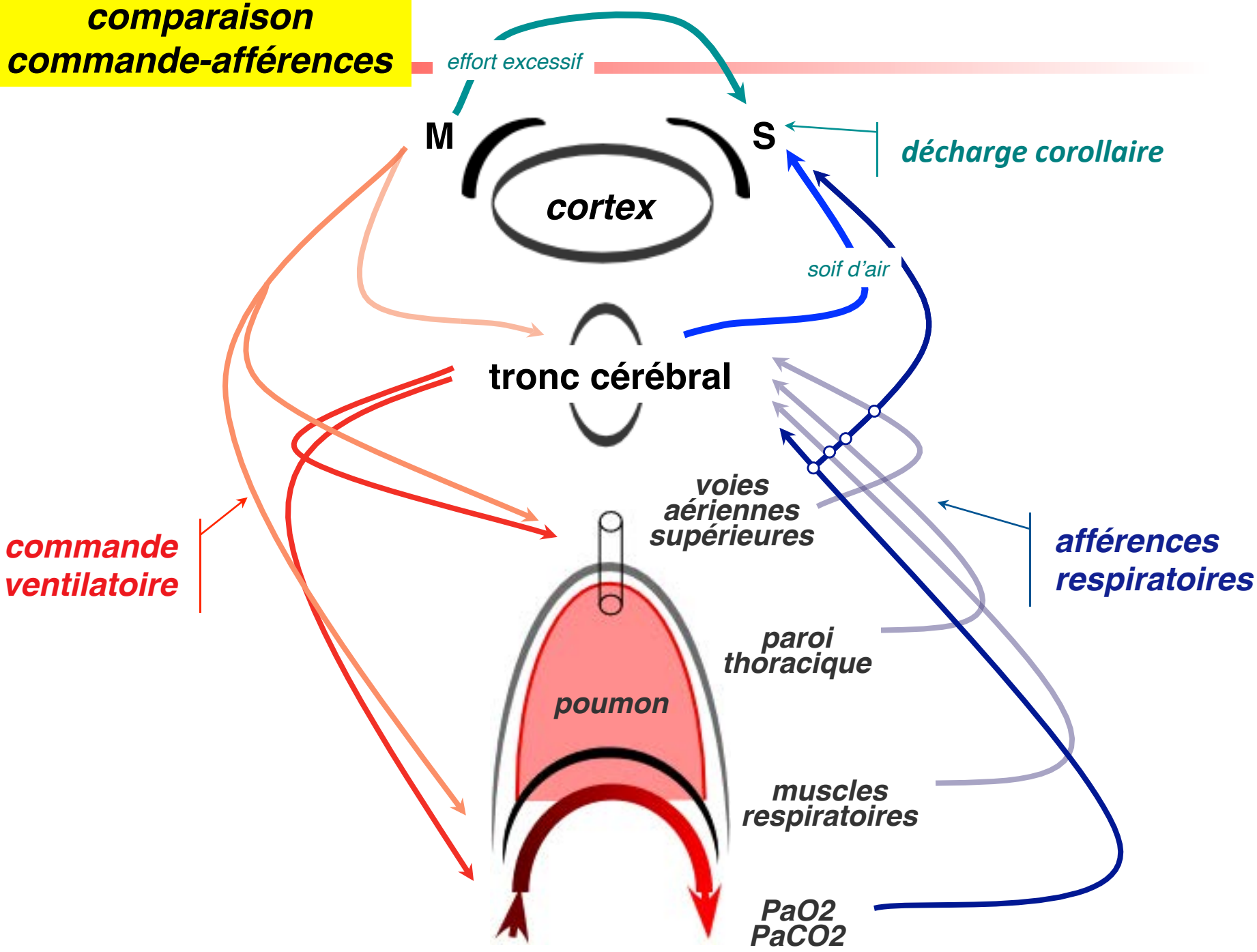

M
S
cortex
tronc cérébral
voies aériennes supérieures
commande ventilatoire
afférences respiratoires
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2

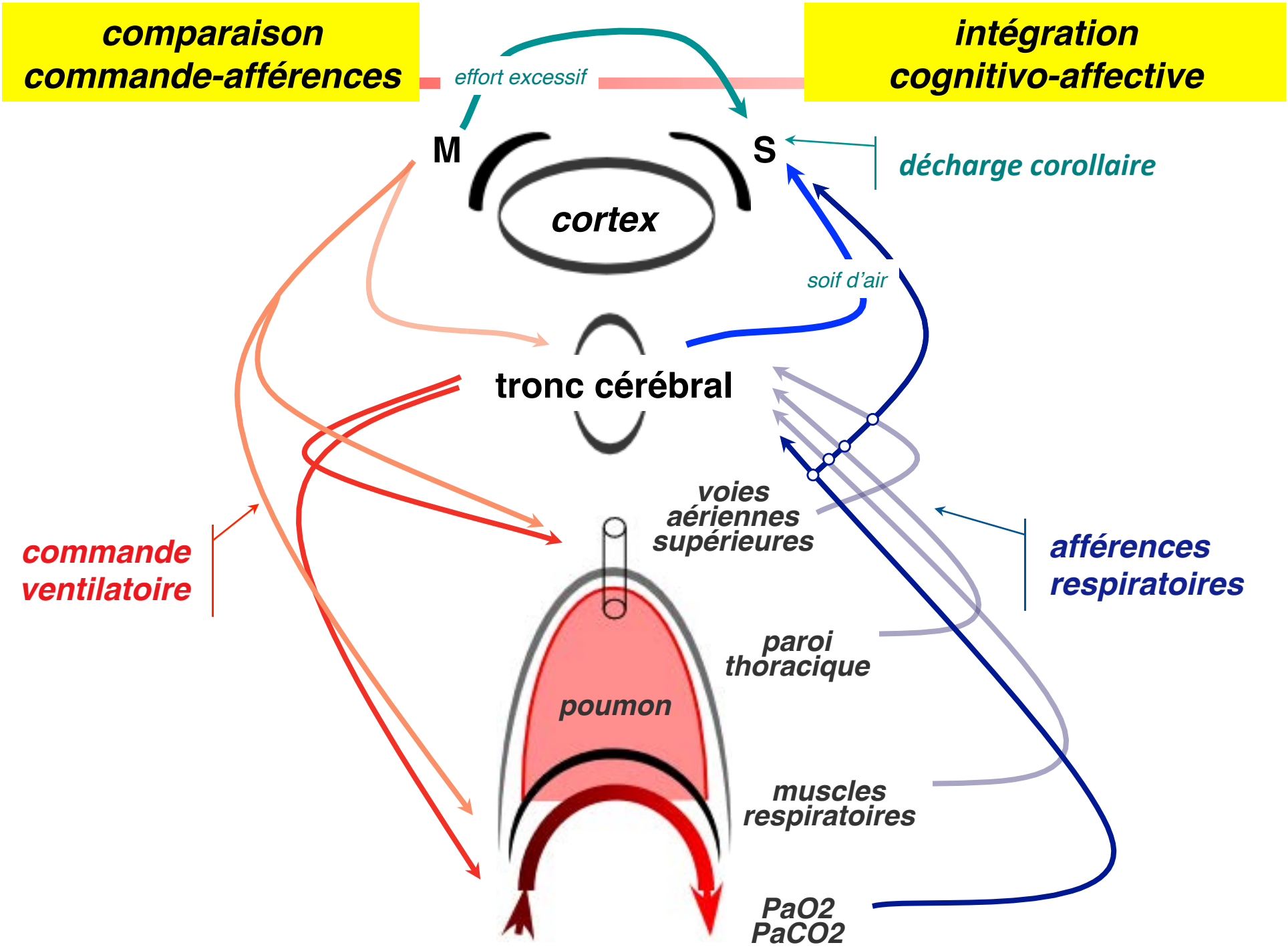

M
S
cortex
tronc cérébral
voies aériennes supérieures
commande ventilatoire
afférences respiratoires
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2

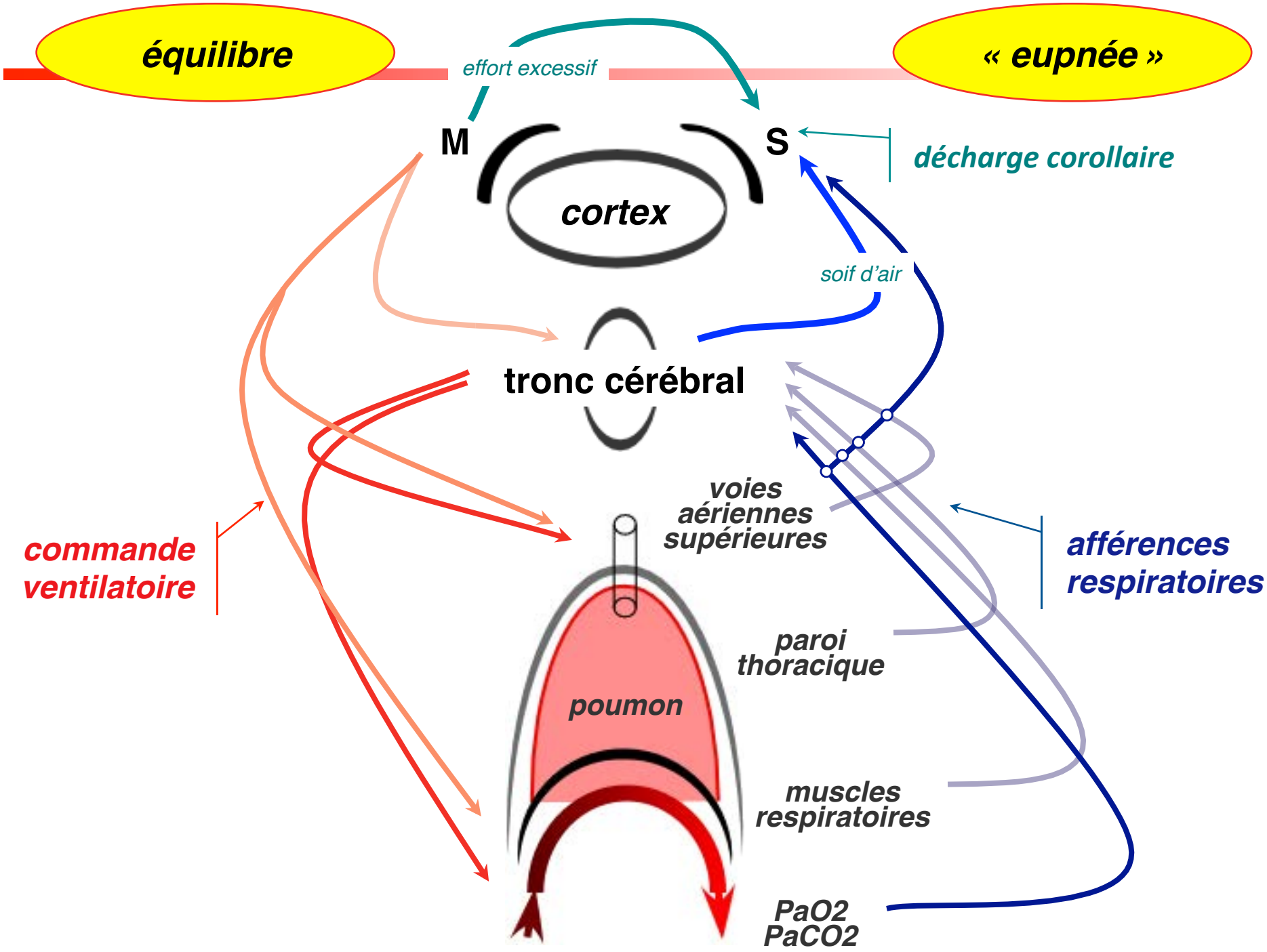

M
S
décharge corollaire
cortex
tronc cérébral
voies aériennes supérieures
commande ventilatoire
afférences respiratoires
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2

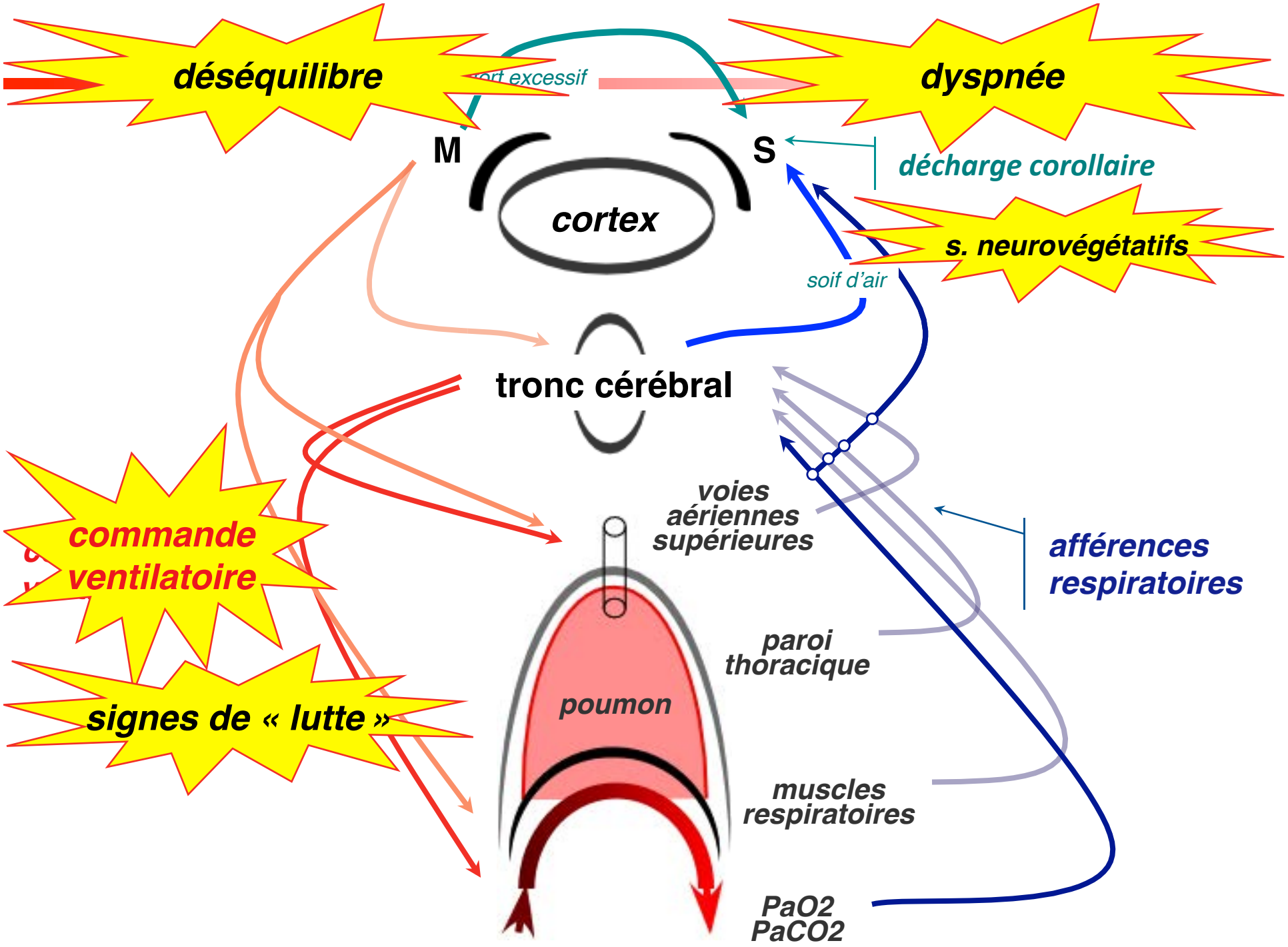

effort excessif
M
S
décharge corollaire
cortex
soif d'air
tronc cérébral
voies aériennes supérieures
commande ventilatoire
afférences respiratoires
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2

comparaison commande-afférences

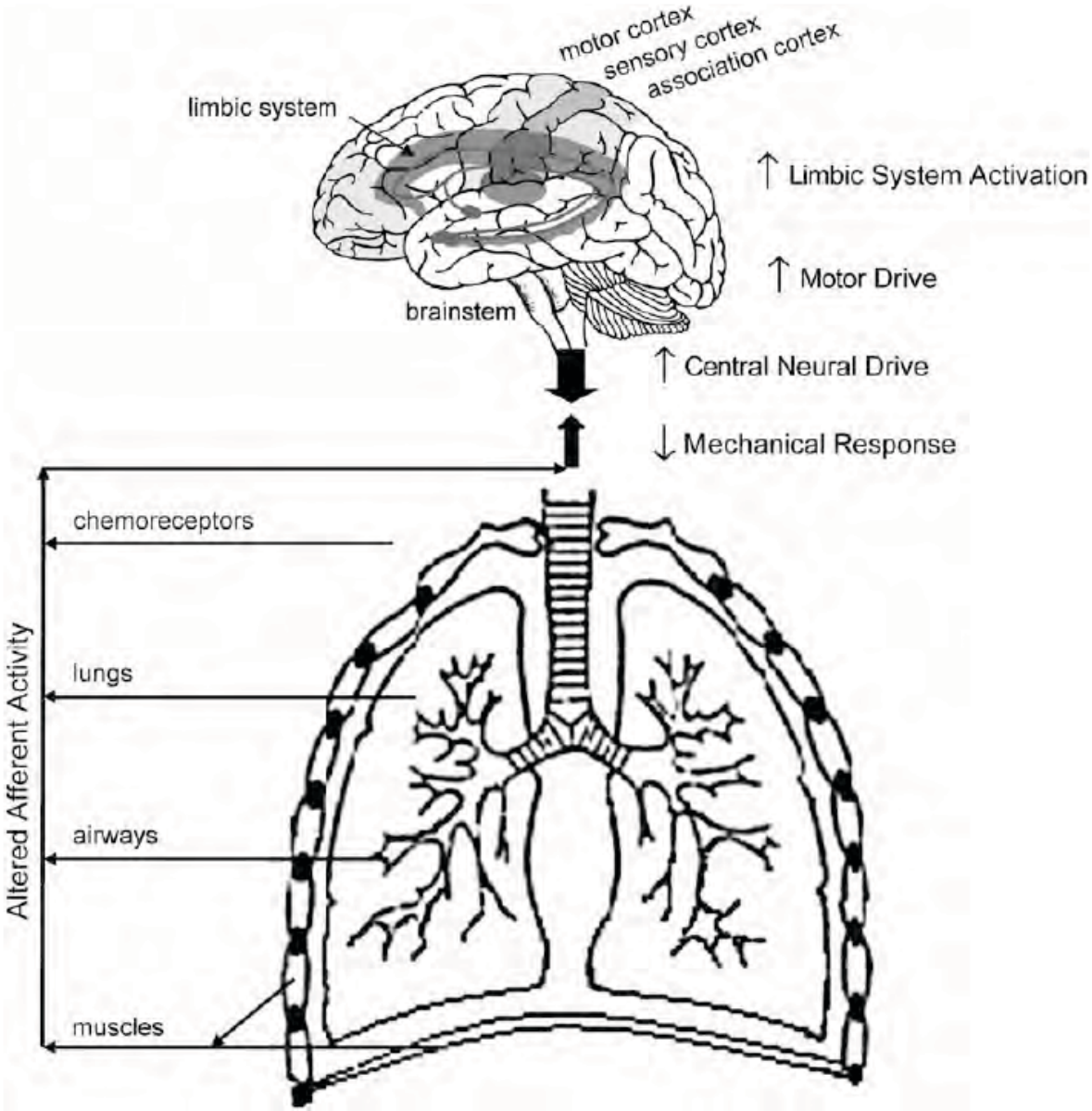



comparaison
commande-afférences
effort excessif
intégration
cognitivo-affective
M
S
décharge corollaire
cortex
soif d'air
tronc cérébral
voies
aériennes
supérieures
commande
ventilatoire
afférences
respiratoires
paroi
thoracique
poumon
muscles
respiratoires
PaO2
PaCO2


équilibre
effort excessif
« eupnée »
M
S
décharge corollaire
cortex
soif d'air
tronc cérébral
voies aériennes supérieures
commande ventilatoire
afférences respiratoires
paroi thoracique
poumon
muscles respiratoires
PaO2
PaCO2

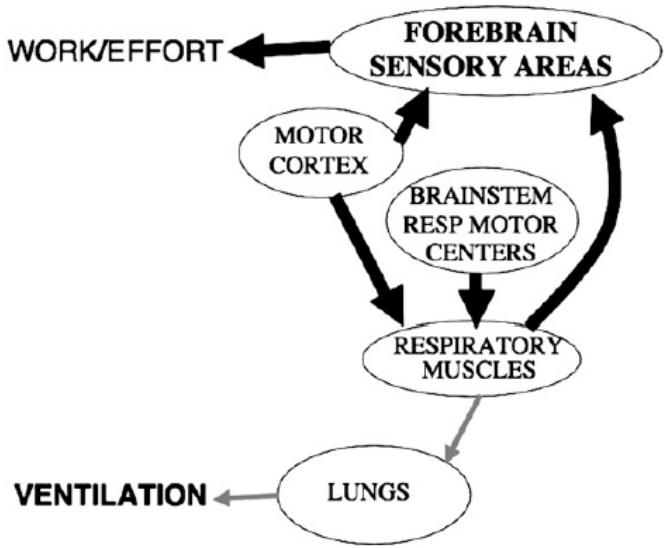

déséquilibre
ort excessif
dyspnée
M
S
décharge corollaire
cortex
s. neurovégétatifs
soif d'air
tronc cérébral
commande ventilatoire
voies aériennes supérieures
afférences respiratoires
paroi thoracique
signes de « lutte »
poumon
muscles respiratoires
PaO2
PaCO2

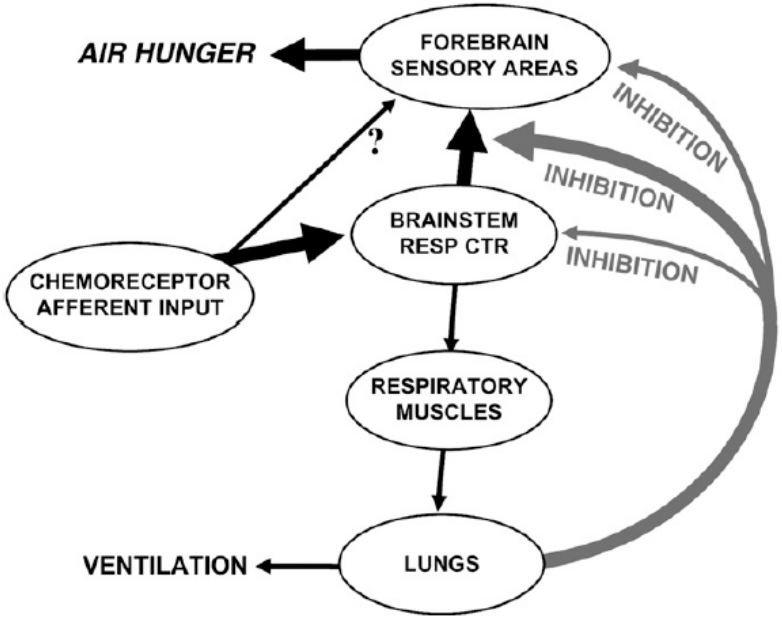
physiopathologie



O'Donnell, Proc Am Thorac Soc, 2007

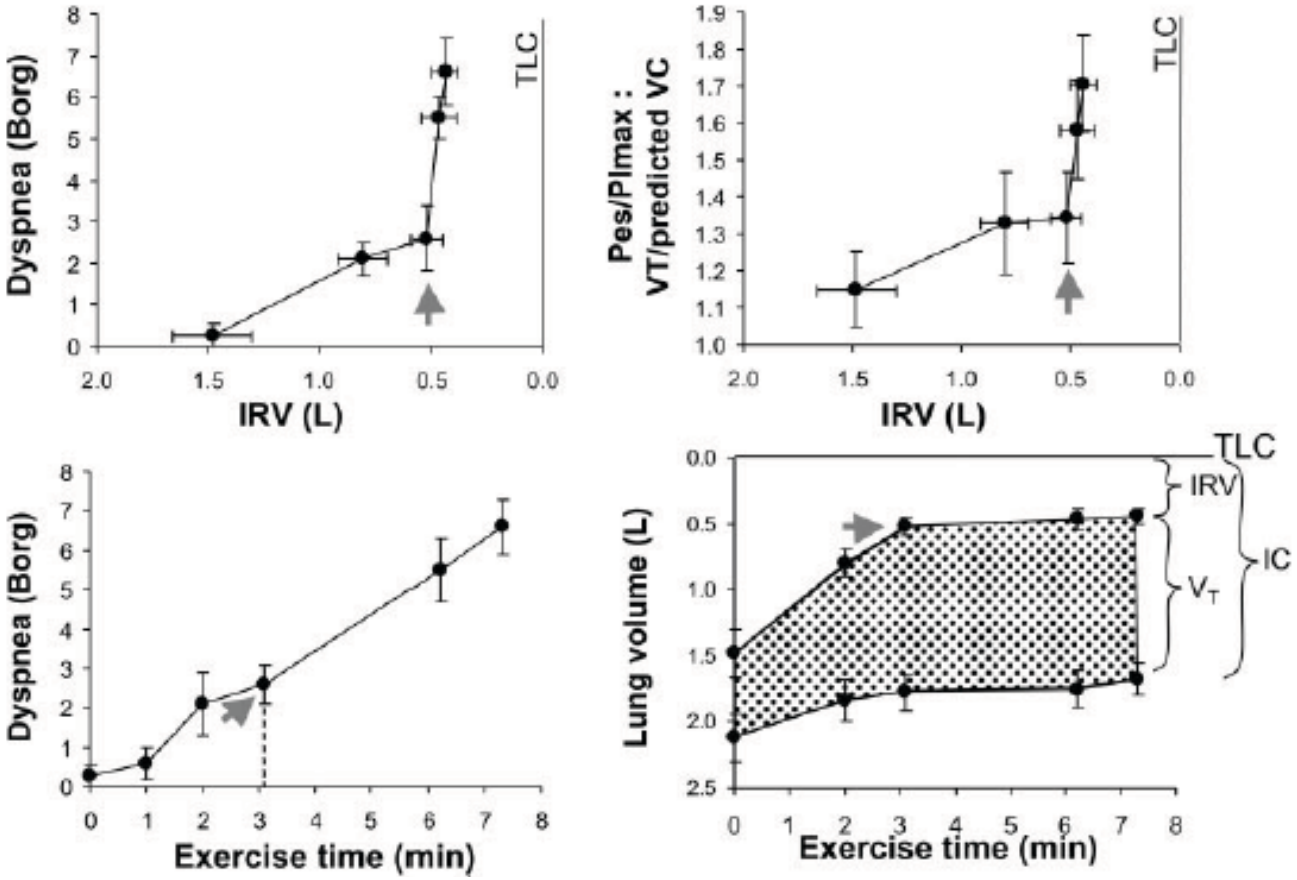
physiopathologie





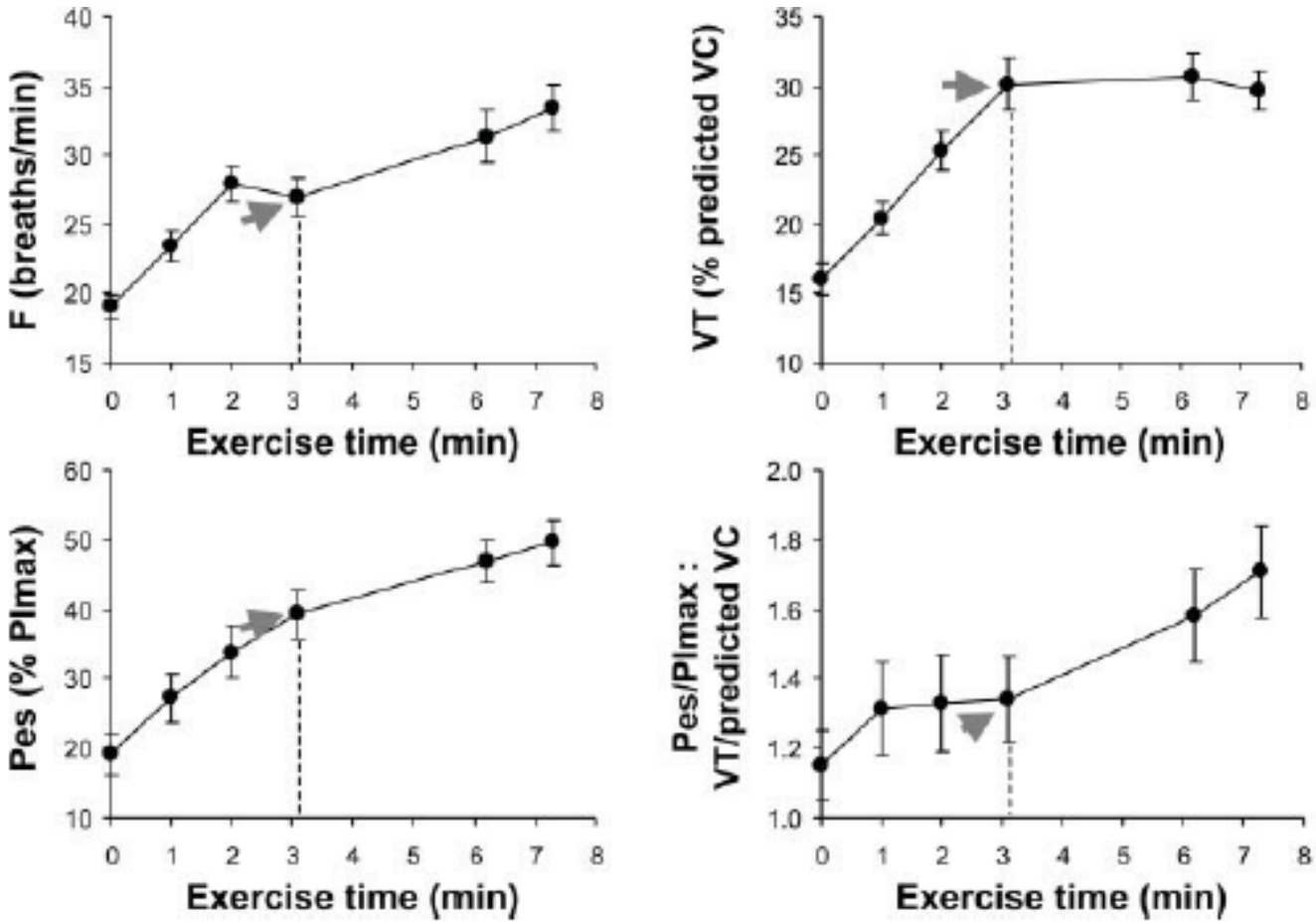
O'Donnell, Proc Am Thorac Soc, 2007

physiopathologie



O'Donnell, J Appl Physiol, 2006

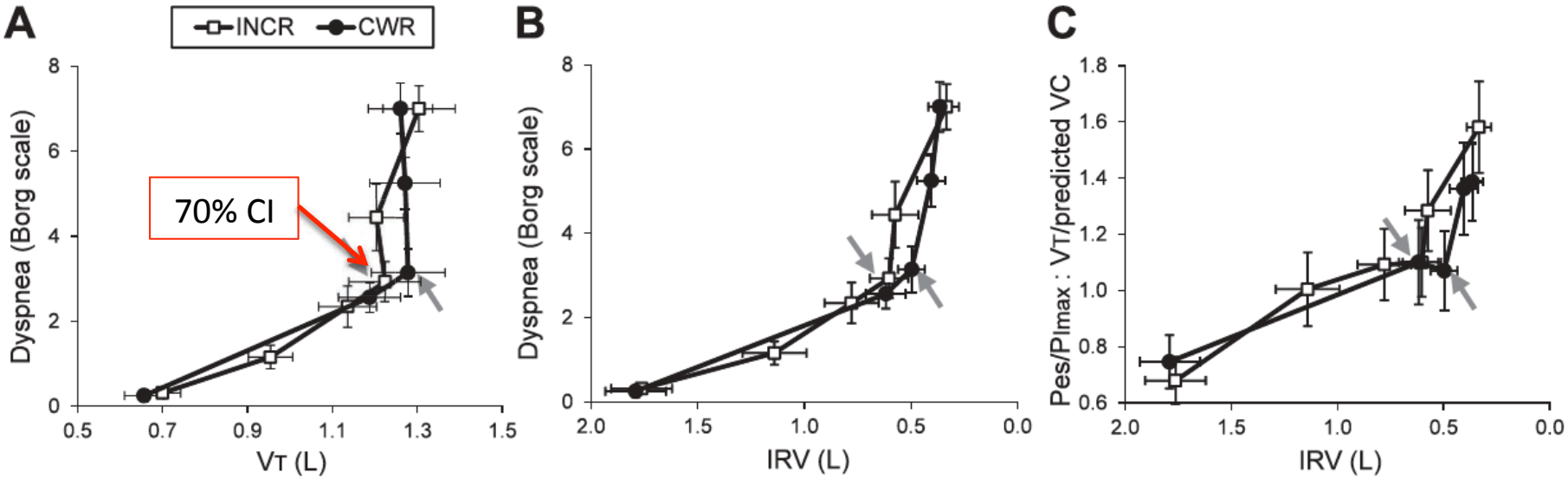
physiopathologie



O'Donnell, J Appl Physiol, 2006

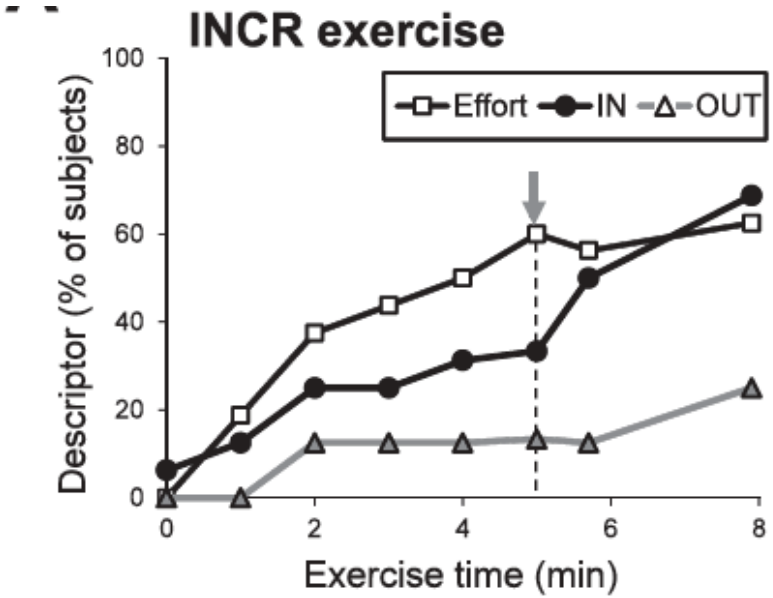
physiopathologie

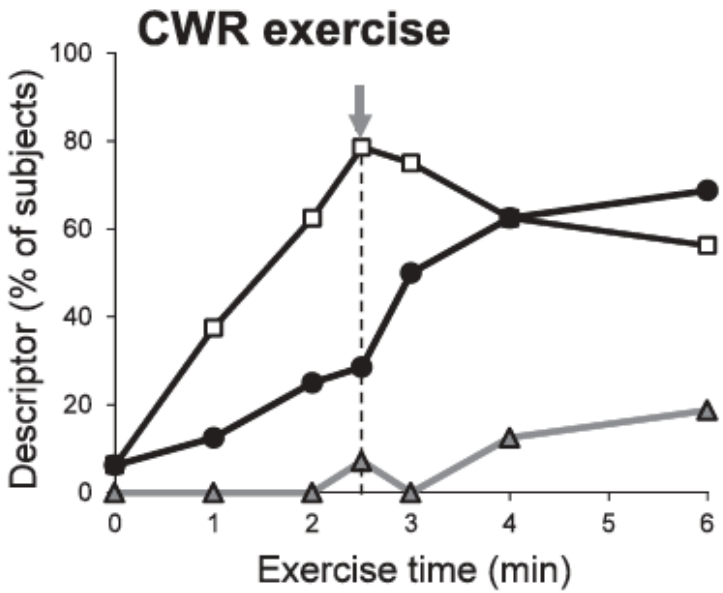
BPCO stades II et III



Laveneziana, AJRCCM, 2011

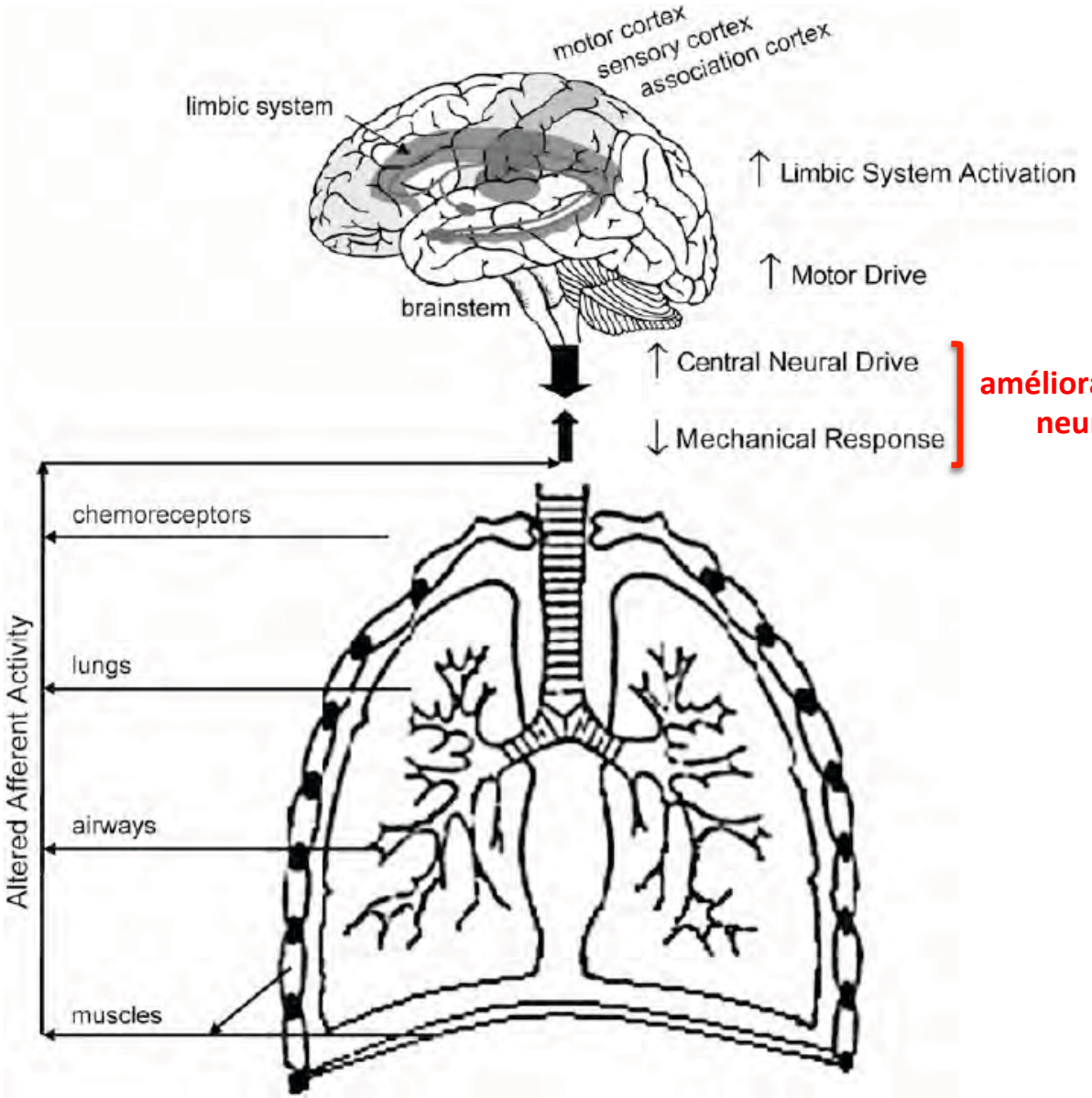
physiopathologie





Laveneziana, AJRCCM, 2011

traitement



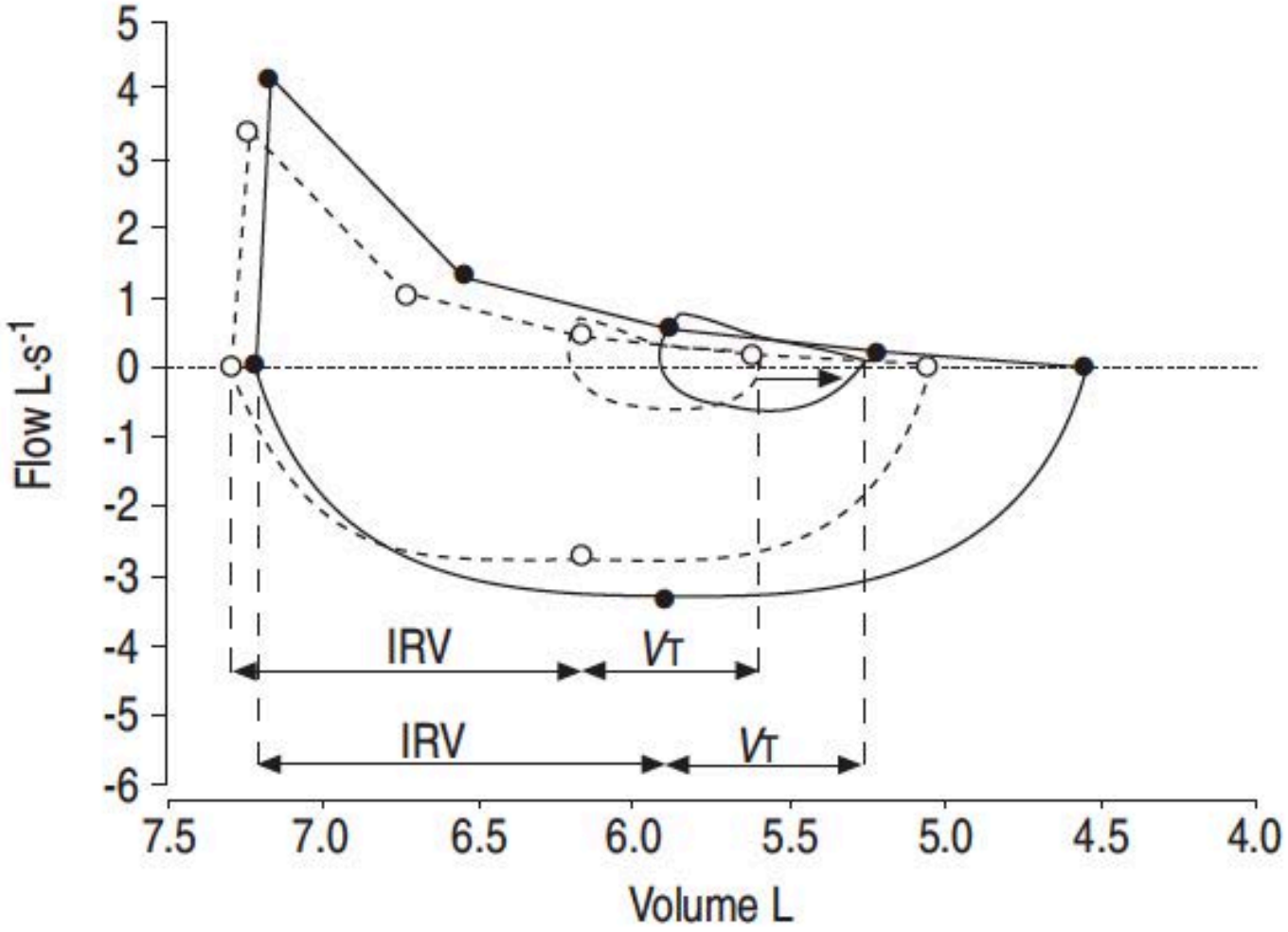
amélioration du couplage neuro-mécanique

O'Donnell, Proc Am Thorac Soc, 2007

amélioration du couplage neuro-mécanique

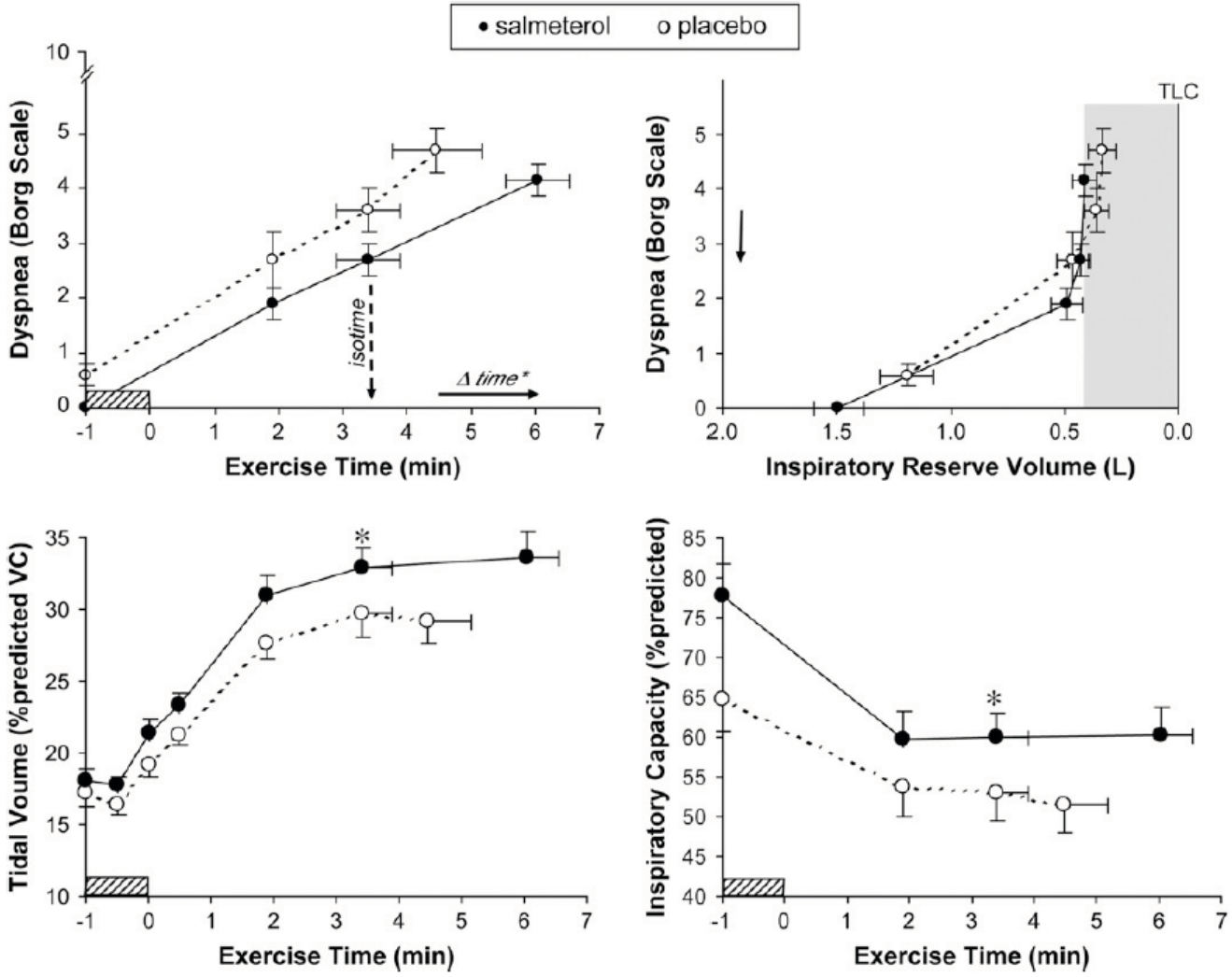
quel bénéfice des bronchodilatateurs
sur la dyspnée ?

bronchodilatateurs - salméterol



O'Donnell, Proc Am Thorac Soc, 2007

bronchodilatateurs - salméterol



O'Donnell, Proc Am Thorac Soc, 2007

bronchodilatateurs - salméterol

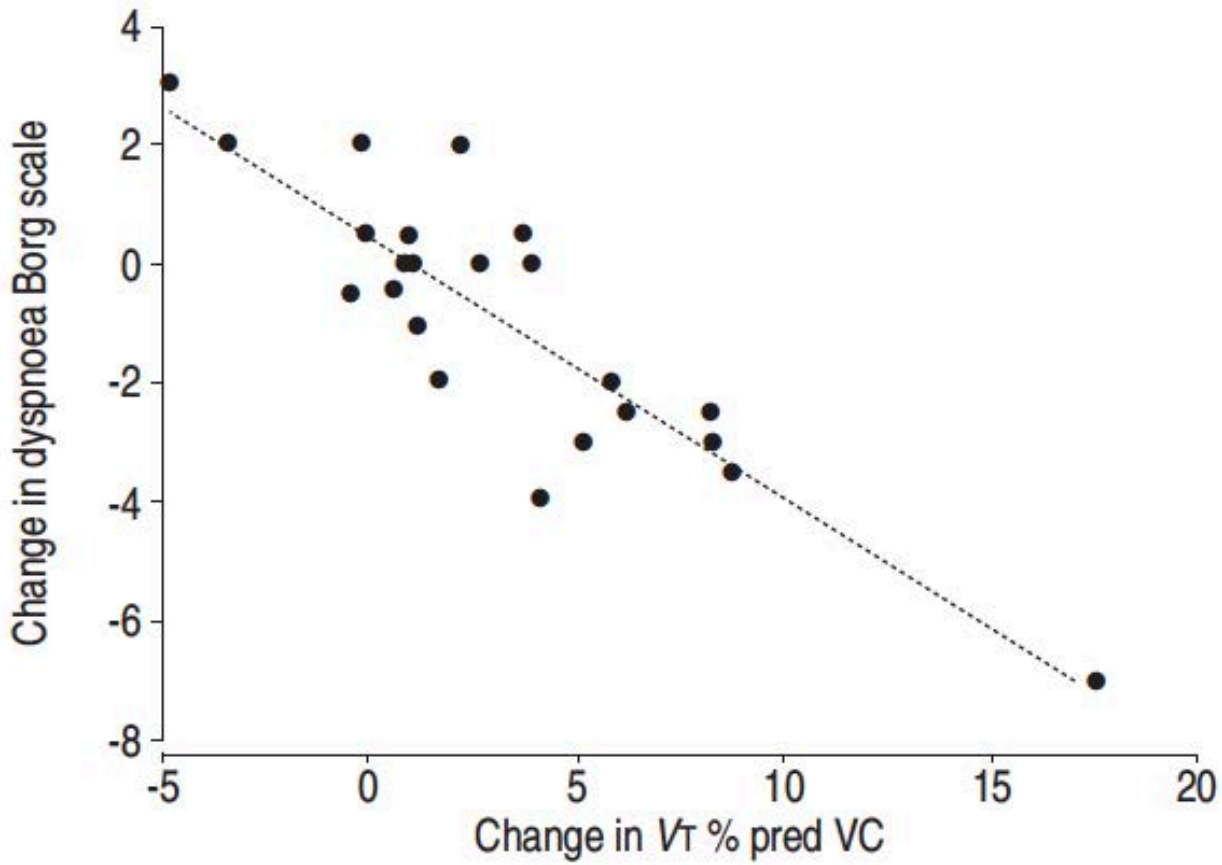
Table 5. – Measurements at a standardised time¶ during constant-load exercise after treatment with placebo and salmeterol

	Placebo	Salmeterol
Dyspnoea Borg	3.6±0.4	2.7±0.3#
Leg discomfort Borg	4.0±0.3	3.7±0.4
$V'O_2$ mL·kg^{-1}·min^{-1}	14.1±0.9	14.7±1.1
$V'CO_2$ L·min^{-1}	1.01±0.10	1.09±0.12*
$V'E$ L·min^{-1}	31.9±2.4	34.0±2.7*
$V'E/V'CO_2$	33.5±1.3	33.0±1.2
fR breaths·min^{-1}	29.0±1.2	27.7±1.2
VT L	1.12±0.09	1.23±0.08*
IC L	1.48±0.11	1.65±0.09*
Change in IC from rest L	-0.34±0.04	-0.50±0.05*
IRV L	0.36±0.05	0.43±0.03

réduction arrêt pour dyspnée : 3 vs 11
réduction « manque d'air » : 61% vs 83%
réduction « effort » : 43% vs 52%

O'Donnell, ERJ, 2004

bronchodilatateurs - salméterol



réduction de dyspnée corrélée à :

- augmentation du VT : r=-0,88
- augmentation de la CI dynamique : r=-0,76
- augmentation de la CI de repos : r=-0,75

O'Donnell, ERJ, 2004

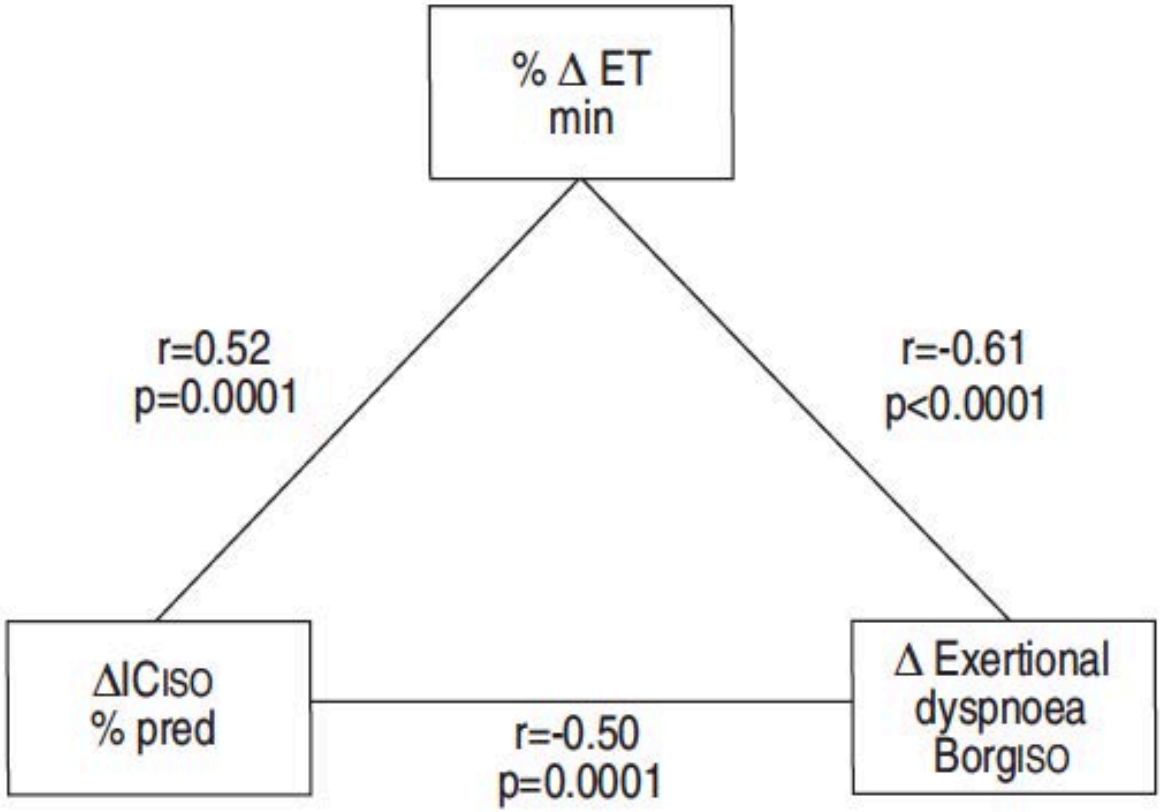
bronchodilatateurs - tiotropium

Table 4. – Treatment differences in exercise test parameters for the tiotropium group compared with the placebo group

	Day 0	Day 21	Day 42
Endurance time s	40±28	67±32*	105±40**
Rest			
Dyspnoea Borg	-0.1±0.1	0.0±0.1	-0.1±0.1
IC L	0.25±0.04#	0.21±0.04#	0.23±0.05#
V_T L	0.03±0.02	-0.02±0.02	0.00±0.03
f_R breaths·min^{-1}	0.2±0.4	0.6±0.5	0.6±0.5
V'_E L·min^{-1}	0.2±0.4	0.2±0.4	0.4±0.4
IRV L	0.22±0.05#	0.23±0.05#	0.23±0.05#
Isotime exercise			
Dyspnoea Borg	-0.5±0.2*	-0.7±0.3*	-0.9±0.3**
IC L	0.21±0.04#	0.19±0.05#	0.18±0.05***
V_T L	0.09±0.03***	0.15±0.03#	0.11±0.03***
f_R breaths·min^{-1}	-0.6±0.5	-0.7±0.6	-0.5±0.6
V'_E L·min^{-1}	1.8±0.7*	3.3±1.1**	3.0±0.8***
IRV L	0.13±0.04***	0.08±0.04*	0.08±0.04*

O'Donnell, ERJ, 2004

bronchodilatateurs - tiotropium

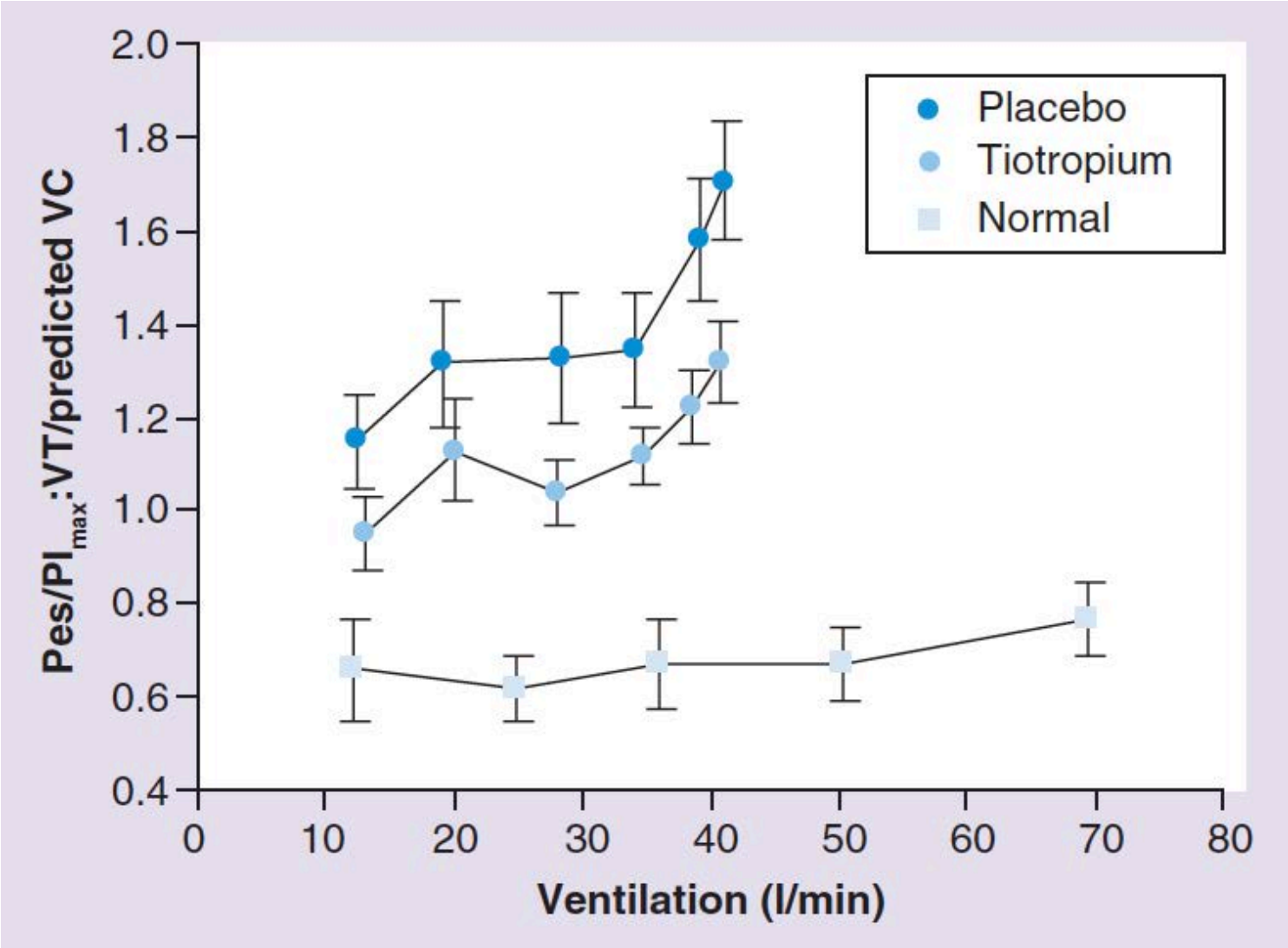


réduction de dyspnée corrélée à :

- augmentation du temps endurance
- augmentation de la CI dynamique

O'Donnell, ERJ, 2004

bronchodilatateurs - tiotropium



réduction de l'effort musculaire inspiratoire → réduction de « effort »

Lavaneziana, Expert Rev Resp Med, 2012

bronchodilatateurs combinés

Table 3 Isotime measurements during submaximal exercise in the baseline visit and post-dose after a 2-week treatment ($N = 26$).

Variables	Formoterol + Placebo		Formoterol + Tiotropium	
	Baseline	Treatment	Baseline	Treatment
Ventilatory				
$\dot{V}_E$, L	31.7 ± 11.2	32.0 ± 10.4	31.7 ± 11.9	33.4 ± 11.7
$\dot{V}_E$/MVV	0.79 ± 0.20	0.71 ± 0.13*	0.80 ± 0.20	0.68 ± 0.13*
V_T	1.06 ± 0.32	1.14 ± 0.3*	1.02 ± 0.31	1.18 ± 0.35*
f, rpm	30 ± 6	28 ± 6*	31 ± 8	28 ± 7*
IC, L	1.40 ± 0.42	1.59 ± 0.41*	1.39 ± 0.40	1.72 ± 0.43*
ΔIC from rest, L	−0.43 ± 0.32	−0.45 ± 0.36	−0.41 ± 0.37	−0.27 ± 0.40†
T_I, s	0.72 ± 0.13	0.80 ± 0.19*	0.71 ± 0.14	0.84 ± 0.17*
V_T/T_E, L s^{-1}	0.82 ± 0.32	0.83 ± 0.29	0.82 ± 0.36	0.90 ± 0.34*
Subjective				
Borg dyspnoea scores	7 ± (1–10)	5 ± (0.5–9)*	7 ± (3–10)	5 ± (0–9)*
Borg leg effort scores	3 ± (0–10)	3 ± (0–10)	4 ± (0–10)	2.5 ± (0–9)

pas de bénéfice sur la dyspnée

Berton, Resp Med, 2010

bronchodilatateurs

- amélioration de la capacité inspiratoire de repos
- amélioration de l'expansion du VT
- réduction de la restriction mécanique (VRI)

➡ délai du point d'inflexion

- réduction de l'effort inspiratoire
- amélioration des performances musculaires
- réduction de la PEEP intrinsèque

➡ amélioration du couplage neuro-mécanique

O'Donnell, Proc Am Thorac Soc, 2007

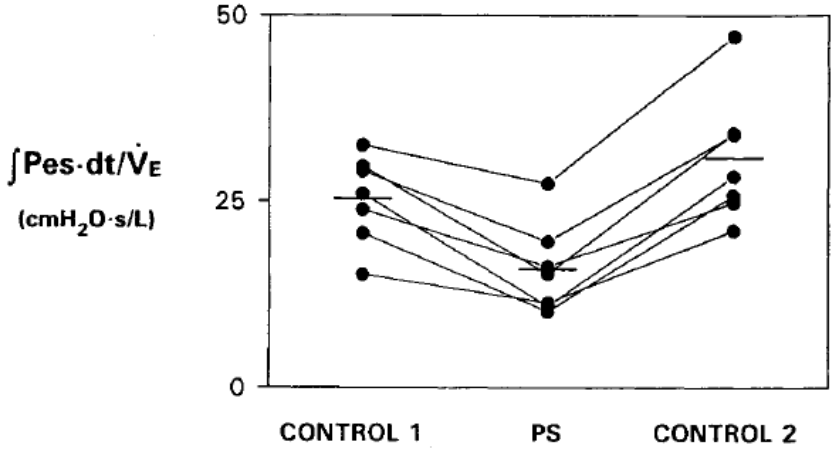
amélioration du couplage neuro-mécanique

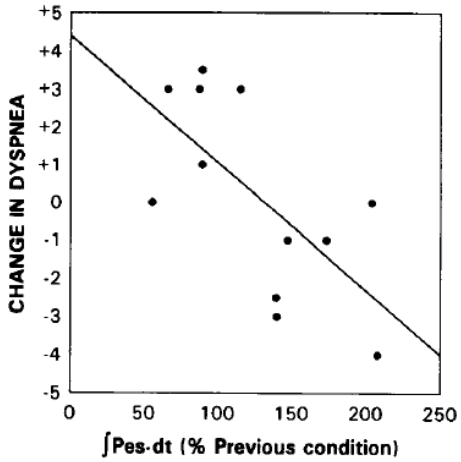
quel bénéfice de la VNI

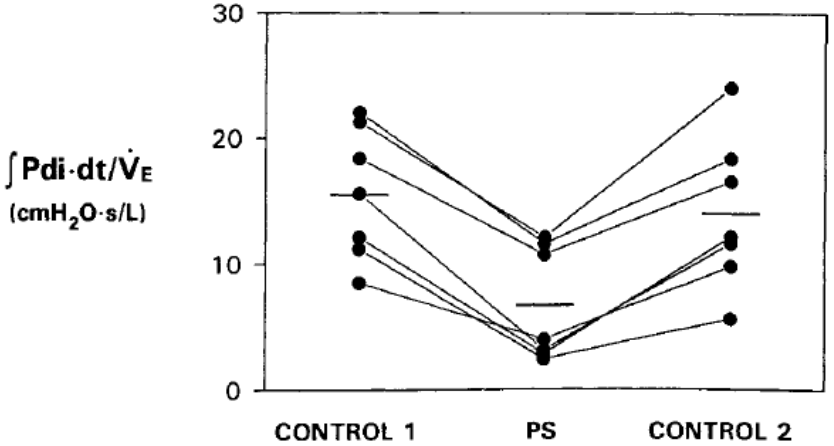
sur la dyspnée ?

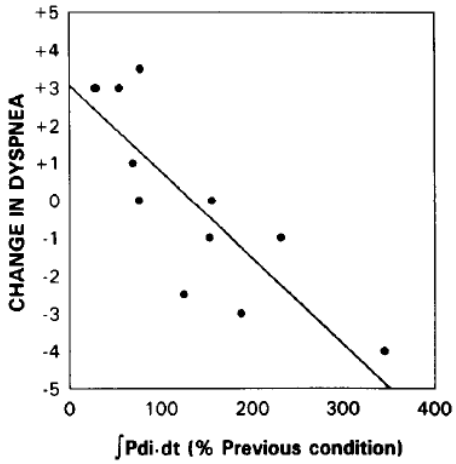
VNI

AI = 11 ± 1 cmH20









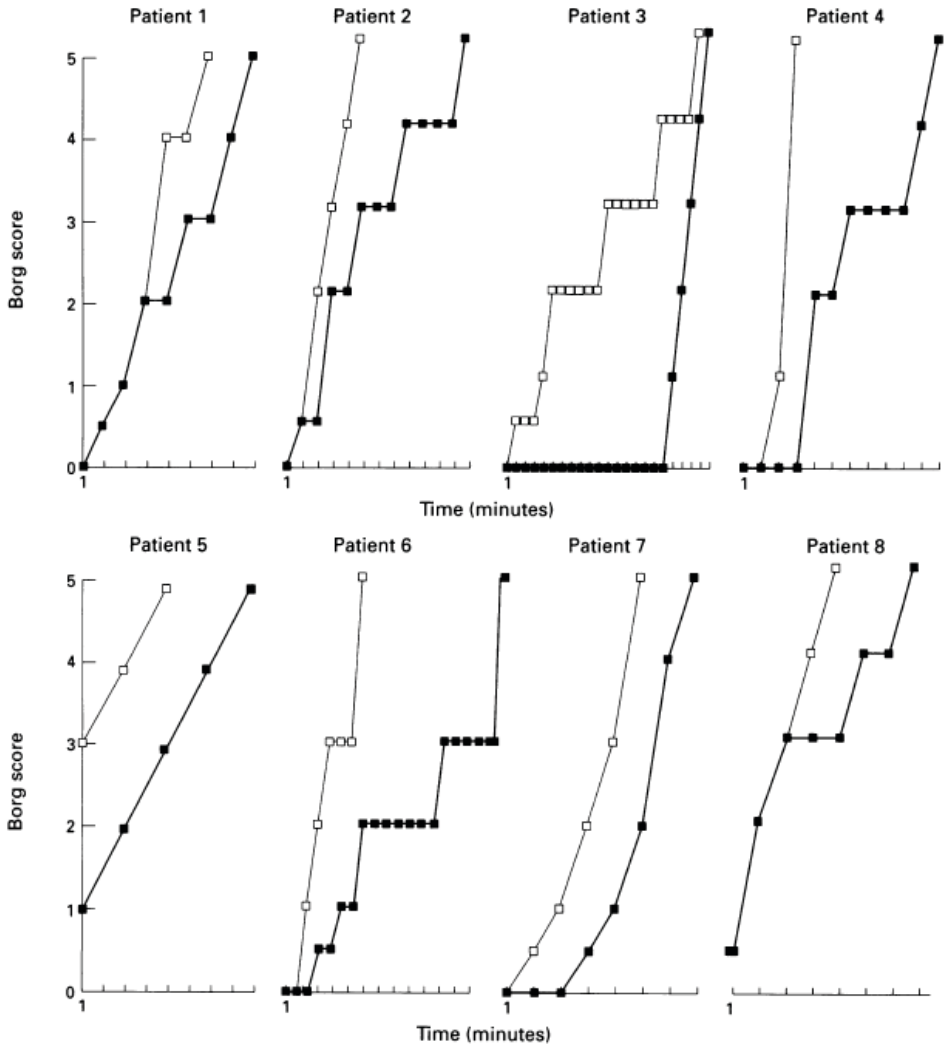
réduction de l'effort musculaire inspiratoire

Maltais, AJRCCM, 1995

VNI

AI = 12-15 cmH20
vs PPC = 6 cmH2O
vs O2=2 L/min

	contrôle	VNI	contrôle	PPC	contrôle	O2
distance	187(215)	336 (282)	152 (138)	121 (62)	224 (221)	239 (154)



Keilty, Thorax, 1994

VNI

Parameter	Control	Sham	CPAP	PSV	PAV
Endurance time min	7.1±4.6	7.2±4.4	9.6±4.6*	10.5±2*	12.5±6*§#
Borg dyspnoea isotime	6.3±1.4	6.5±1.5	5.3±1.9*	4.4±1.4*§	4.2±1.9*§
Borg leg discomfort isotime	5.0±2.6	5.4±1.9	4.9±2.3	4.1±2.2*	4.2±2.3*
O_2 supply isotime L·min^{-1}	3.8±1.8	3.9±1.9	3.7±2.0	3.1±1.8*§	3.4±1.9*

*: p<0.05 *versus* sham; #: p<0.05 *versus* pressure support ventilation (PSV); §: p<0.05 *versus* continuous positive airway pressure (CPAP). PAV: proportional assist ventilation.

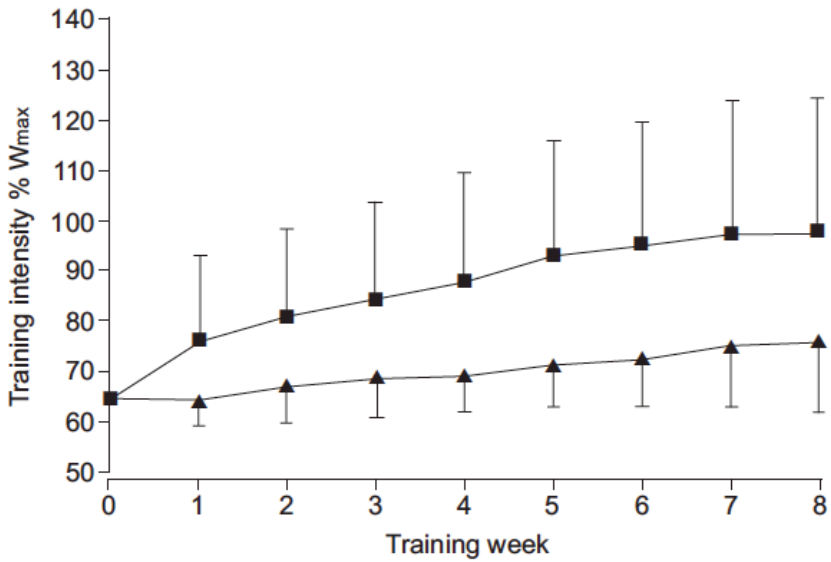
	Sham	CPAP	PSV	PAV
f_C beats·min^{-1}	116±17	111±15	112±10	112±15
P_{et,CO_2} kPa	9.3±1.4	8.0±1.2	7.5±1.2*	7.4±1.0*§
f_R breaths·min^{-1}	34±8	32±8	31±7	30±7
t_I s	0.81±0.23	0.84±0.29	0.81±0.21	0.83±0.21
t_I/t_{tot}	0.44±0.06	0.45±0.09	0.39±0.05*§	0.39±0.07*§
V_T L	1.00±0.39	1.07±0.39	1.15±0.43*	1.14±0.47*
V'_E L·min^{-1}	32.3±10.2	32.6±11.3	34.4±13	33.8±13.1
V_T/t_I L·s^{-1}	1.27±0.43	1.31±0.56	1.50±0.62*§	1.42±0.50*

bénéfice dans la BPCO sévère hypercapnique mais
pas de bénéfice et mauvaise tolérance dans la BPCO légère

Bianchi, ERJ, 1998

Bianchi, Res Med, 2002

VNI



AI=10 cmH2O

AI=5 cmH2O

TABLE 4 St. George's Respiratory Questionnaire

	NIVS group		Control group	
	Baseline	Post-training	Baseline	Post-training
Patients n	14		15	
Symptoms	338±131 (50±19)	296±136 (45±20)	343±139 (52±21)	297±151 (47±24)
Activities	913±234 (76±19)	814±188 (67±15)#	992±150 (82±12)	912±193 (75±16)
Impact	883±362 (42±17)	833±349 (40±16)	890±462 (42±22)	862±451 (40±21)
Total	2213±409 (55±10)	2041±474 (51±12)	2146±697 (54±17)	1973±676 (50±17)

Data are presented as mean±SD (%). NIVS: noninvasive ventilatory support. #: statistically significantly different from pre-training, $p<0.05$.

Van't Hul, ERJ, 2006

VNI

	Supplemental oxygen	NPPV and supplemental oxygen
Before 6MWT		
$Pa_{,}O_2$ mmHg	72.4 ± 5.6	70.7 ± 8.1
$Pa_{,}CO_2$ mmHg	50.4 ± 5.7	50.1 ± 7.4
$Sa_{,}O_2$ %	95.1 ± 1.6	94.7 ± 2.1
pH	7.40 ± 0.02	7.40 ± 0.03
fc	89.5 ± 12.2	87.6 ± 15.7
SBP mmHg	119.5 ± 20.3	122.6 ± 17.2
DBP mmHg	69.8 ± 14.4	70.4 ± 12.6
BDS	0 (0/0)	0 (0/0)
After 6MWT		
$Pa_{,}O_2$ mmHg	61.6 ± 7.9	81.2 ± 12.4
$Pa_{,}CO_2$ mmHg	53.3 ± 6.5	51.5 ± 6.4
$Sa_{,}O_2$ %	88.8 ± 4.0	94.6 ± 3.4
pH	7.37 ± 0.03	7.38 ± 0.03
fc	102.7 ± 14.8	101.5 ± 13.3
SBP mmHg	133.7 ± 24.2	137.5 ± 19.0
DBP mmHg	75.3 ± 15.1	80.6 ± 12.1
BDS	6 (4.5–10)	4 (1.5–4.5)
6MWD m	222.0 ± 84.8	260.7 ± 64.9

Dreher, ERJ, 2007

VNI

- augmentation du VT
- réduction de la restriction mécanique

➡ délai du point d'inflexion?

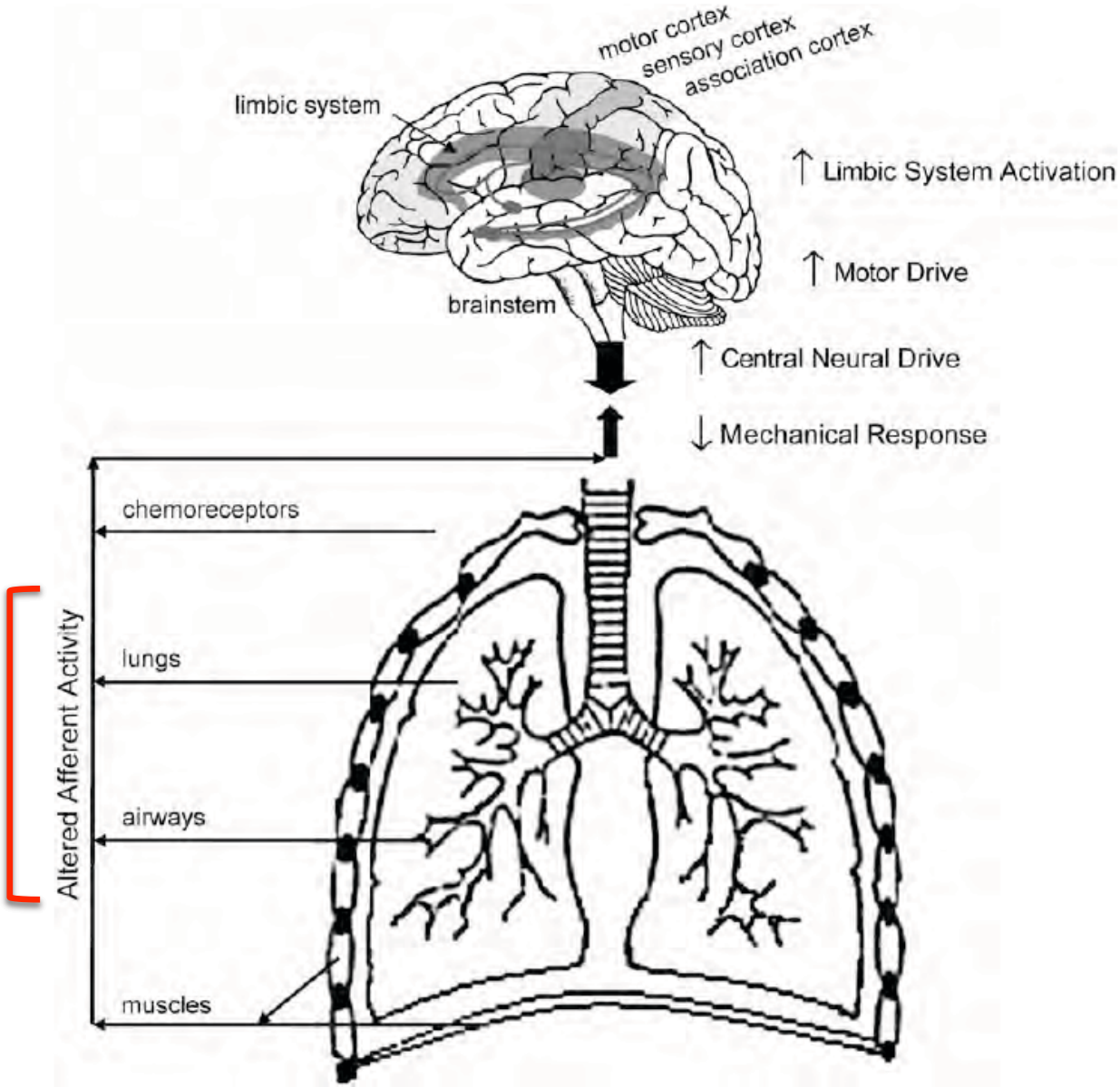
- réduction de l'effort inspiratoire
- amélioration des performances musculaires
- lutte contre la PEEP intrinsèque?

➡ amélioration du couplage neuro-mécanique

…. mais pour quels patients?

tolérance? réglages? interface?

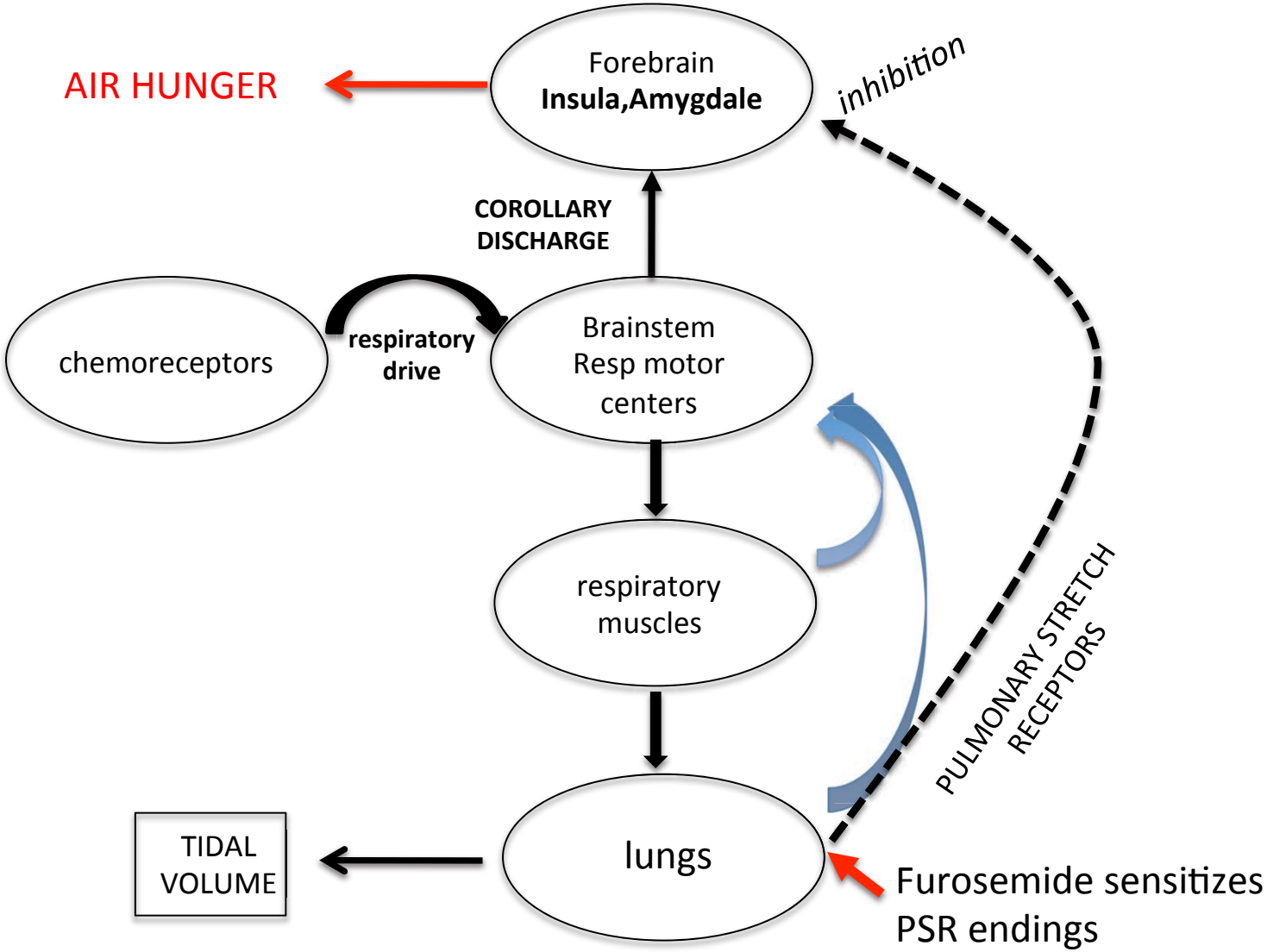
thérapeutiques d'avenir?



augmentation des afférences

O'Donnell, Proc Am Thorac Soc, 2007

furosemide inhalé

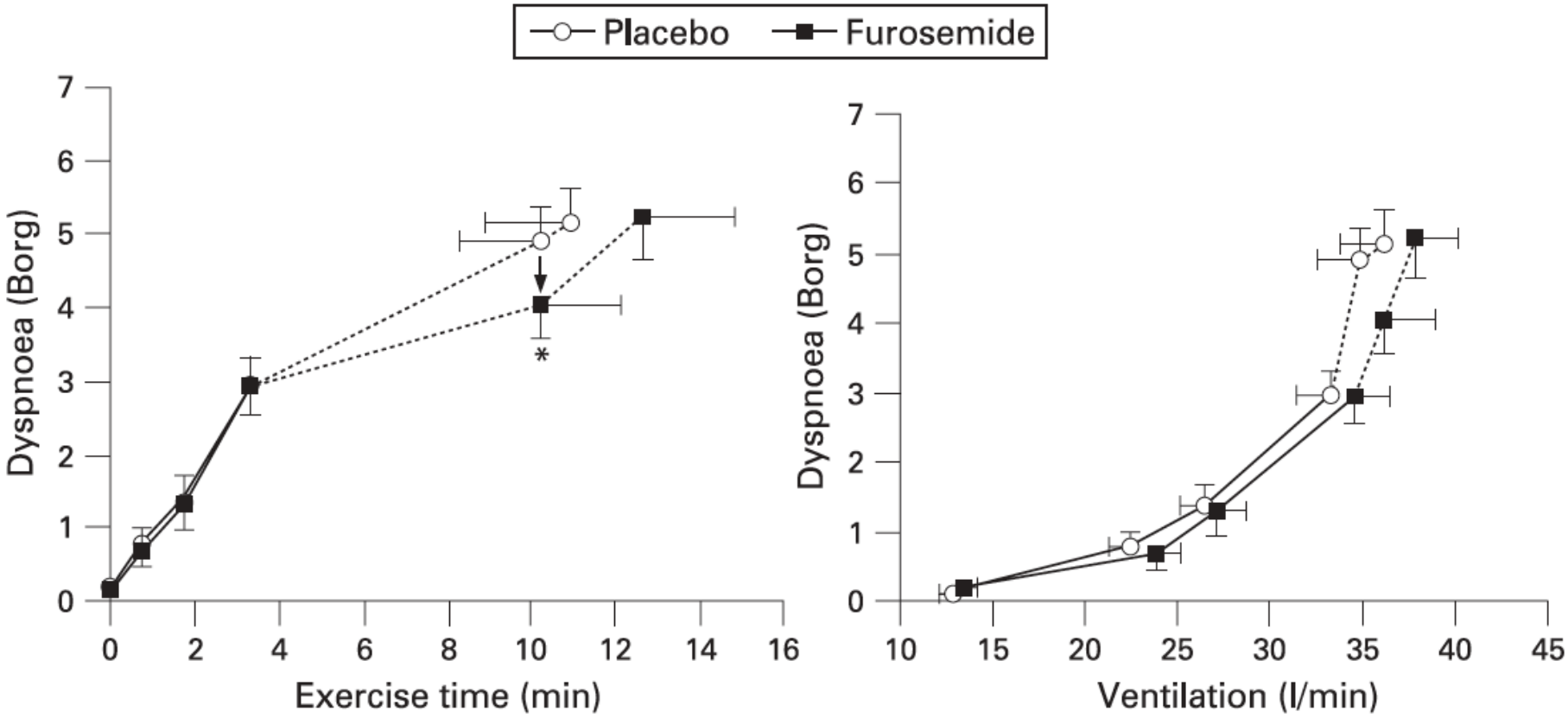


furosemide inhalé

	Isotime	
	Placebo	**Furosemide**
Time (min)	10.2 (8.7)	10.2 (8.7)
Dyspnoea (Borg)	4.9 (2.1)	4.1 (2.2)†
Leg discomfort (Borg)	5.6 (2.5)	5.0 (2.6)
HR (beats/min)	115 (21)	115 (19)
O_2 pulse (ml/beat)	9.5 (3.1)	9.9 (3.7)
$\dot{V}O_2$ (ml/kg/min)	13.6 (3.8)	14.1 (3.7)
$\dot{V}CO_2$ (ml/kg/min)	13.2 (4.1)	14.0 (4.2)*
VE (l/min)	34.8 (10.2)	36.2 (11.9)
Vt (l)	1.17 (0.30)	1.24 (0.33)*
f_R (breaths/min)	30.5 (7.8)	29.6 (7.4)
T_I (s)	0.79 (0.20)	0.82 (0.19)
T_E (s)	1.29 (0.32)	1.30 (0.31)
T_I/T_{TOT} (%)	38.0 (4.1)	38.4 (4.0)*
Vt/T_I (l/s)	1.53 (0.46)	1.56 (0.48)
Vt/T_E (l/s)	0.94 (0.29)	1.00 (0.34)*
IC (l)	1.78 (0.46)	1.90 (0.45)*

Jensen, Thorax, 2008

dyspnée- furosemide inhalé

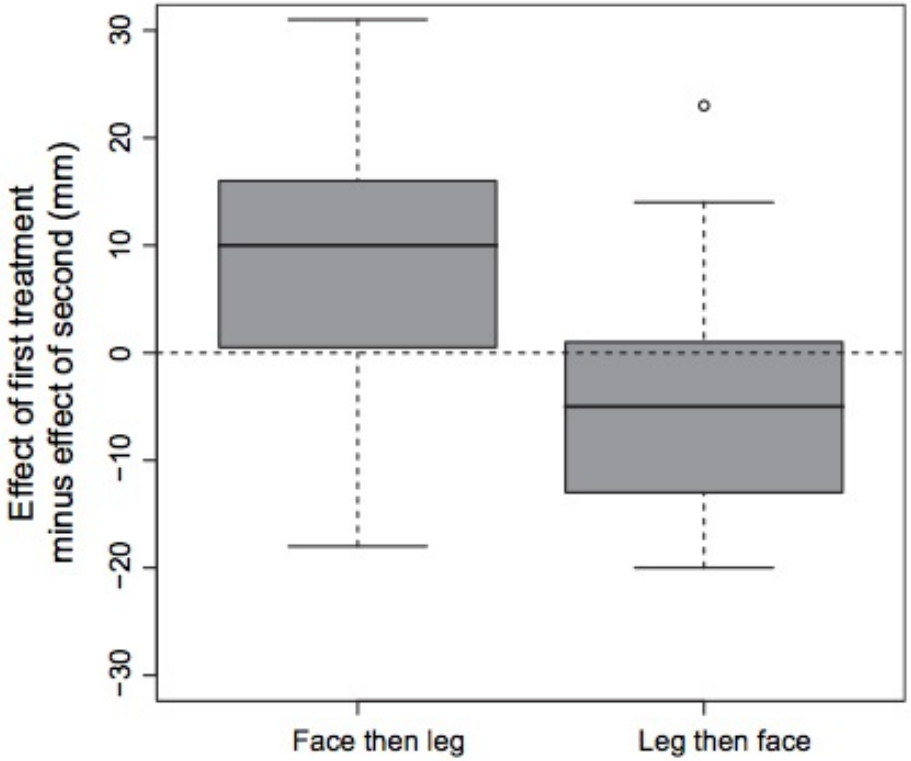


Jensen, Thorax, 2008

ventilateur à ailettes

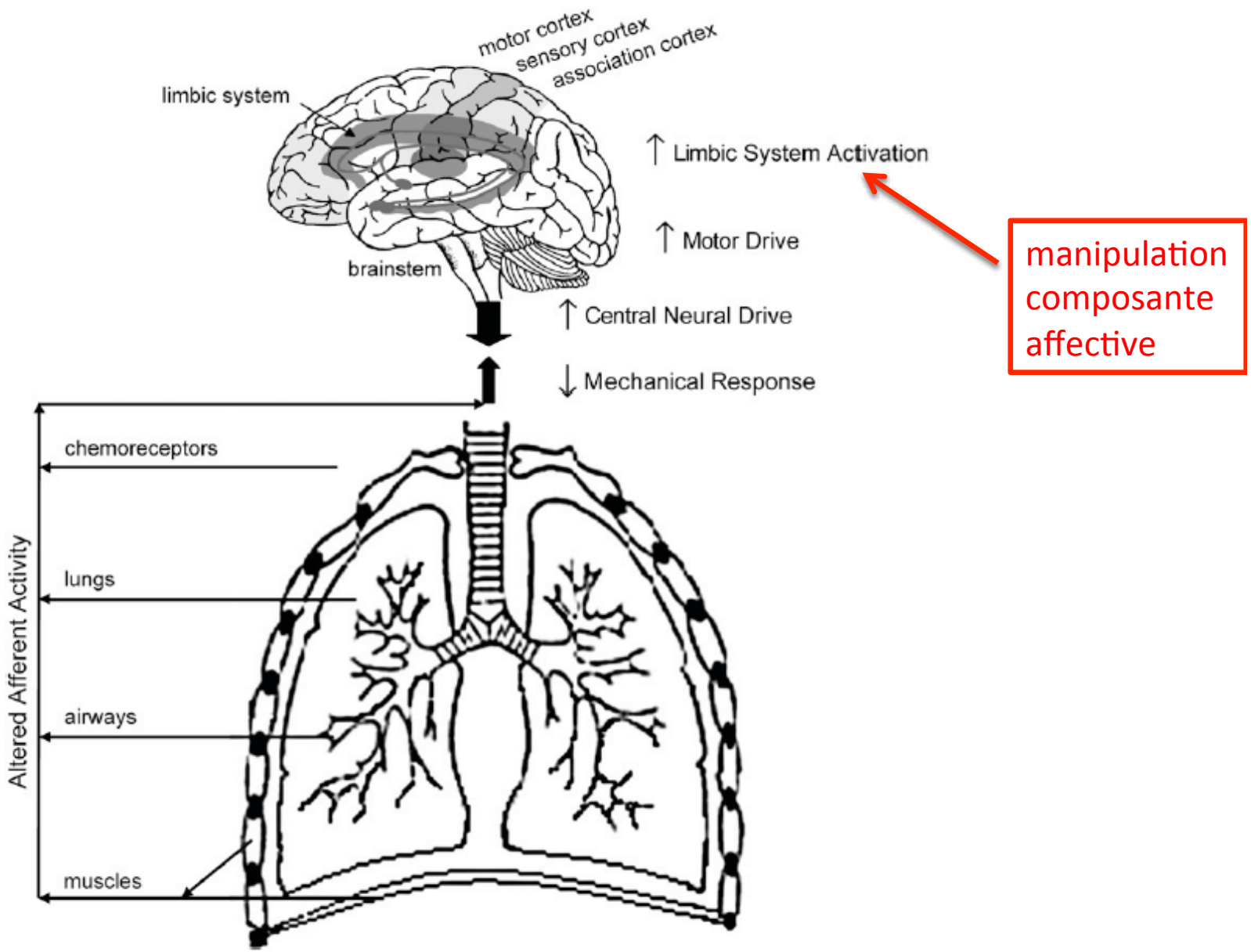
- **patients**
- **dyspnée réfractaire (pathologie maligne ou non**

(compétition sensorielle — gating —)

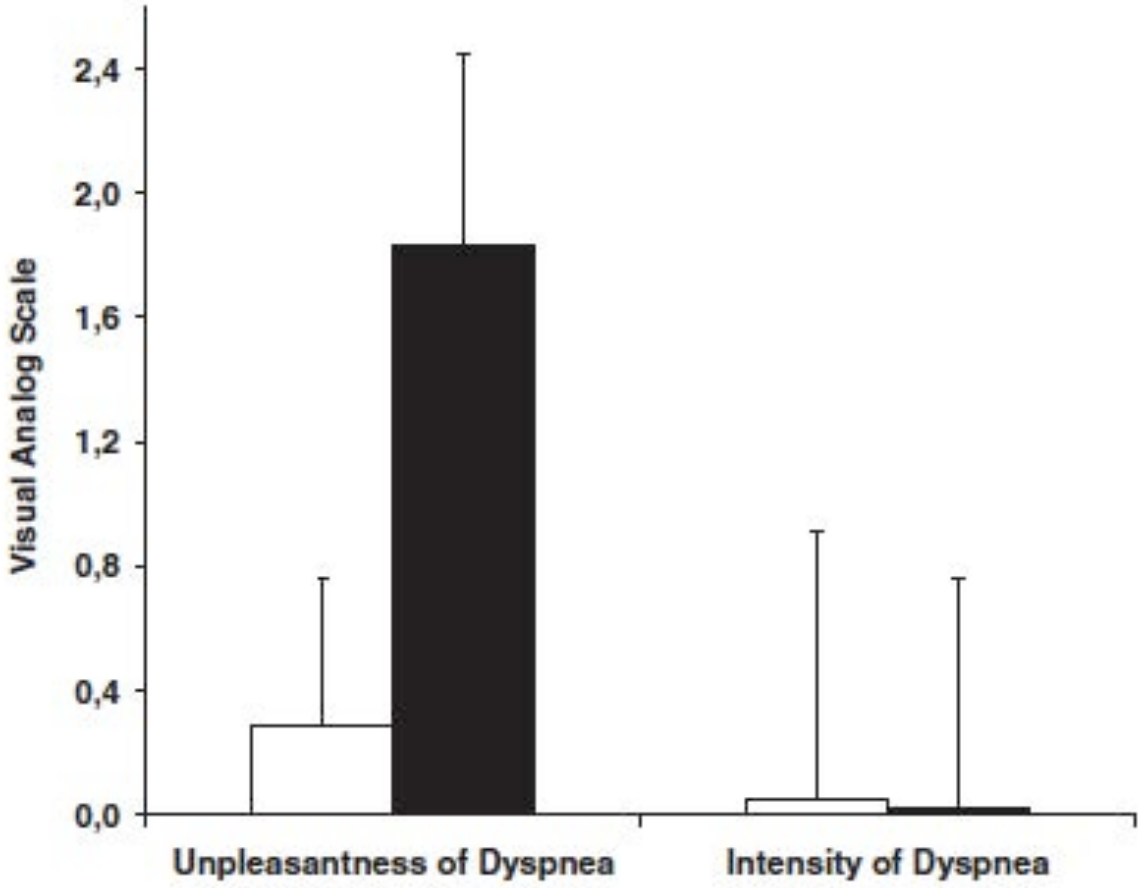


Galbraith, J Pain Symptom Manage 2010

thérapeutiques d'avenir?

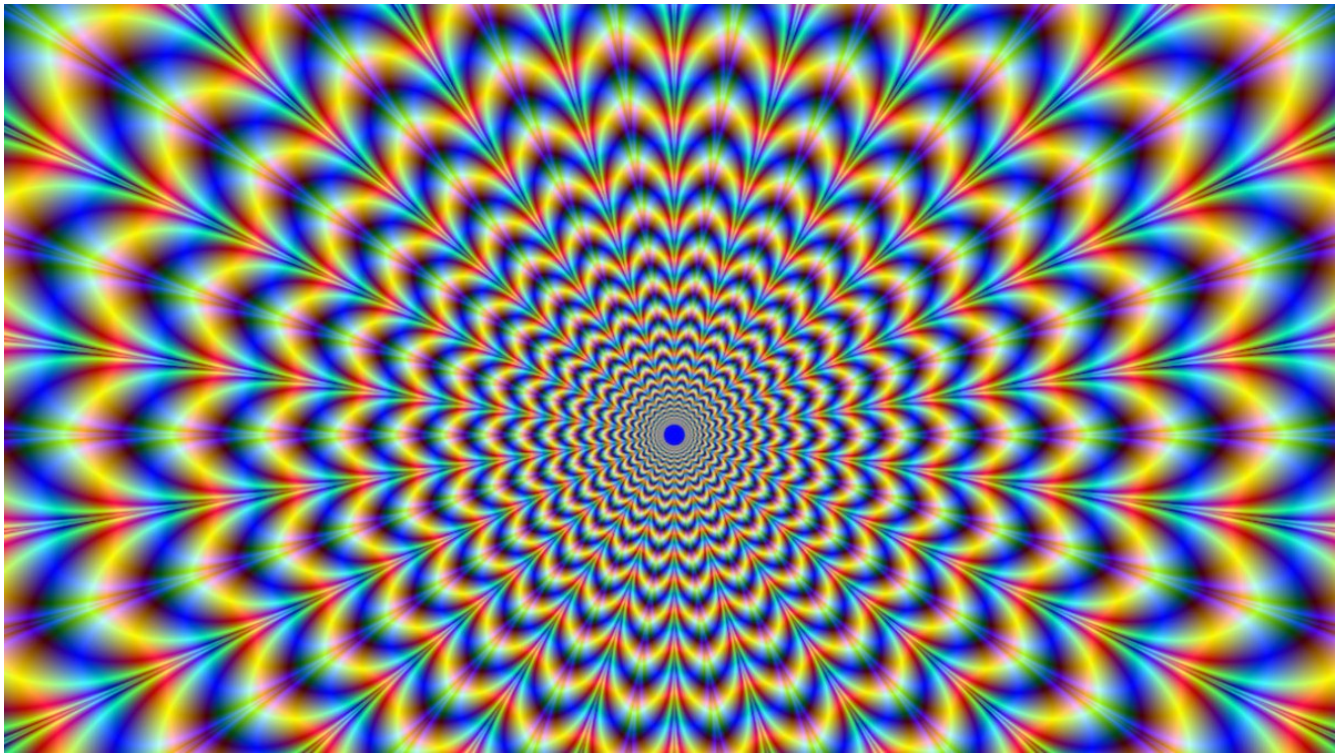


distraction musicale



Von Leupoldt, Chest, 2007

hypnose



Self-Hypnosis for Management of Chronic Dyspnea in Pediatric Patients

Ran D. Anbar

Pediatrics 2001;107;e21

perspectives

Philips' VitaBreath is the first handheld intermittent pressure support device available to COPD patients to help relieve their shortness of breath

Portable, non-pharmaceutical intermittent PAP device complements existing COPD therapies, giving patients the confidence to live active lives

Like 0 +

October 15, 2015 Email Print

London, UK – Philips Respironics, a business of Royal Philips (NYSE: PHG AEX: PHIA), today introduced VitaBreath, a new, intermittent portable positive airway pressure (PAP) device that uses only ambient air to give COPD (Chronic Obstructive Pulmonary Disease) sufferers relief from activity related shortness of breath in less than two minutes. Available first to clinicians in the UK, followed by Australia and India later this year, VitaBreath can help reduce breathlessness recovery time by up to 40 percent[1], enabling COPD patients to gain the confidence to live fuller, more active lives.

In the UK alone, approximately 30,000 people die from COPD every year. Roughly one million have been diagnosed, while another two million go undiagnosed, according to the British Lung Foundation. Many COPD patients restrict their activities dramatically because they are worried about experiencing shortness of breath. Some COPD patients become breathless so quickly that they struggle to complete daily activities such as climbing the stairs or leaving their homes.

Breathlessness is a distressing symptom of COPD which persists in many patients despite treatment with long acting bronchodilators.[2] "Patients who regularly experience episodes of dyspnoea need immediate relief and can't wait several minutes for a medication to take effect," said Dr Robert Angus, consultant in respiratory medicine at Aintree University Hospital. "VitaBreath is a new approach with early research showing that it can improve recovery times for people suffering with dyspnoea. VitaBreath is a genuinely exciting clinical proposition—one that I believe has the potential for becoming a standard-of-care in the future."

Socialise with Philips

Global News Center

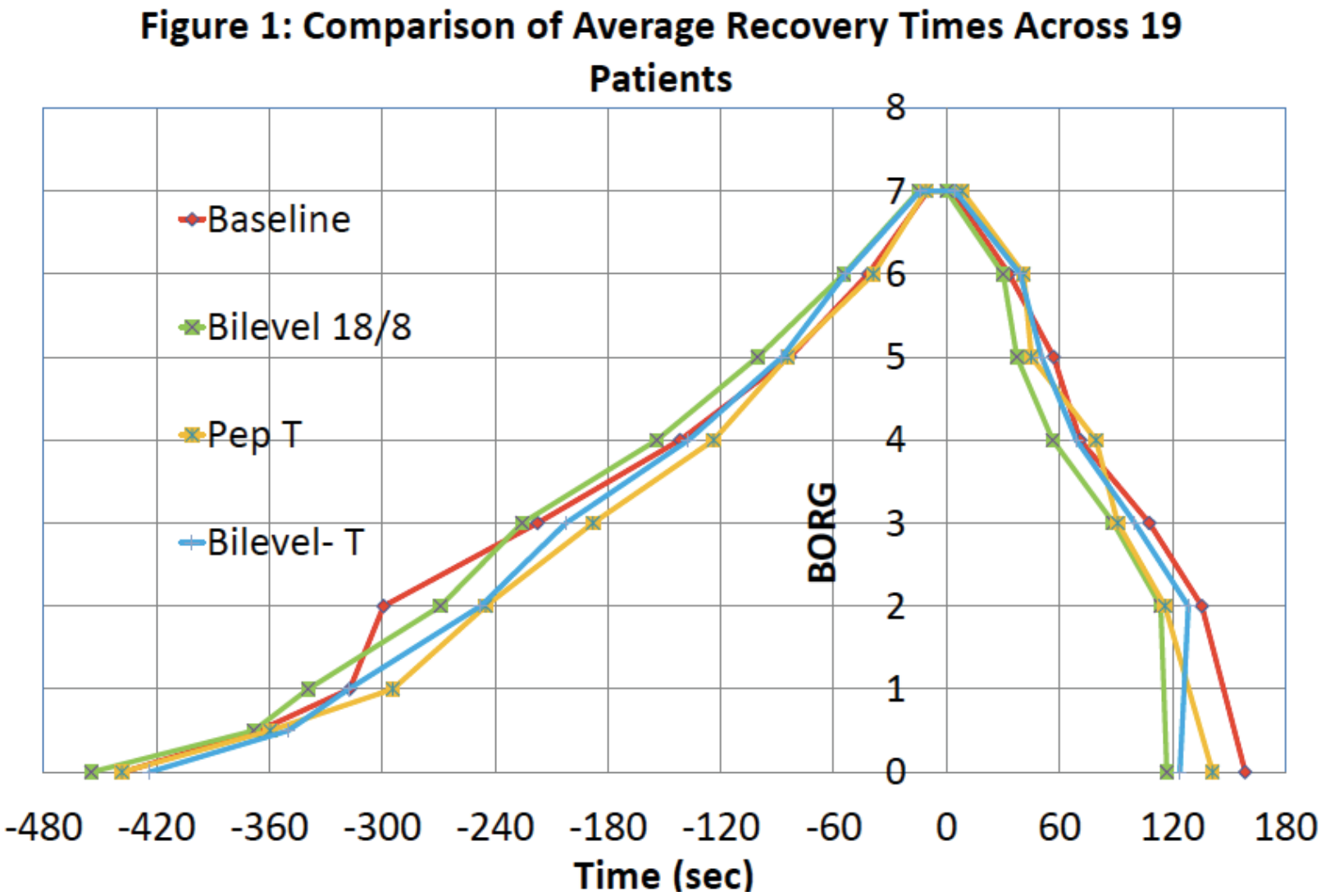
Download

+ Download .JPG

Download

+ Download .JPG

perspectives



Mahadevan, ERS, 2014

perspectives

- réduction de l'effort inspiratoire
- augmentation du VT
- gating sur le nerf trijumeau

mais ….
nécessité d'études supplémentaires

conclusion

- la VNI soulage significativement la dyspnée mais quelle population ?
- problème d'interface et de réglages : ventilateur portatif à la demande ?
- effets additifs avec d'autres traitement?
  - ✓ furosémide
  - ✓ hypnose – autohypnose
  - ✓ musique
  - ✓ ventilateur à ailette