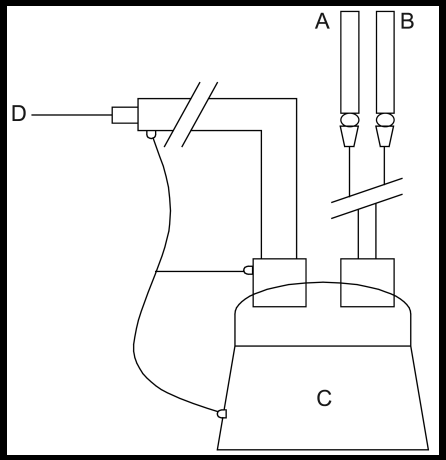
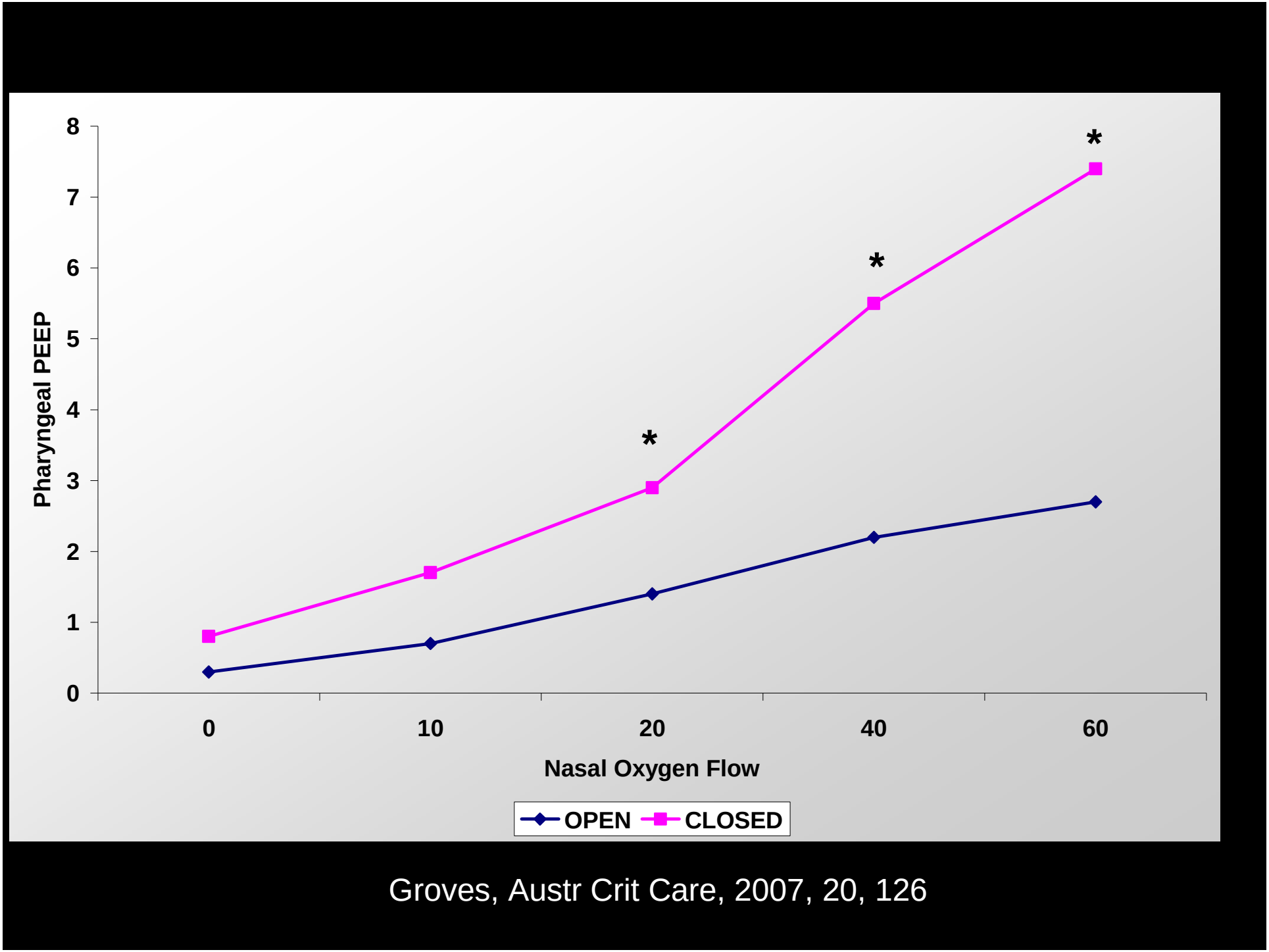
High Flow Oxygenotherapy: mechanisms of action

1. Nasopharyngeal Deadspace Washout
2. Work of Breathing (WOB) reduction (« inspiratory support »)
3. Respiratory mechanics Improvement
4. Conditionning metabolic cost reduction
5. « Distending pressures »
6. High FiO_2





Groves, Austr Crit Care, 2007, 20, 126

Linear Regression :

PEEP

δ +0.8 cm H_2O / δ 10 L.min^{-1}	**flow**
δ -0.5 cm H_2O/ δ 10 cm	**height**
δ -0.6 cm H_2O	male **gender**
δ + 2 cm H_2	**mouth closed**

Groves, Austr Crit Care, 2007, 20, 126

Female finer facial features

N =15

SNHD 35 $L.min^{-1}$

Fréquence respiratoire = 14 min^{-1}

Pas de sous-groupe suivant le sexe

Valeurs moyennes de pression pharyngée

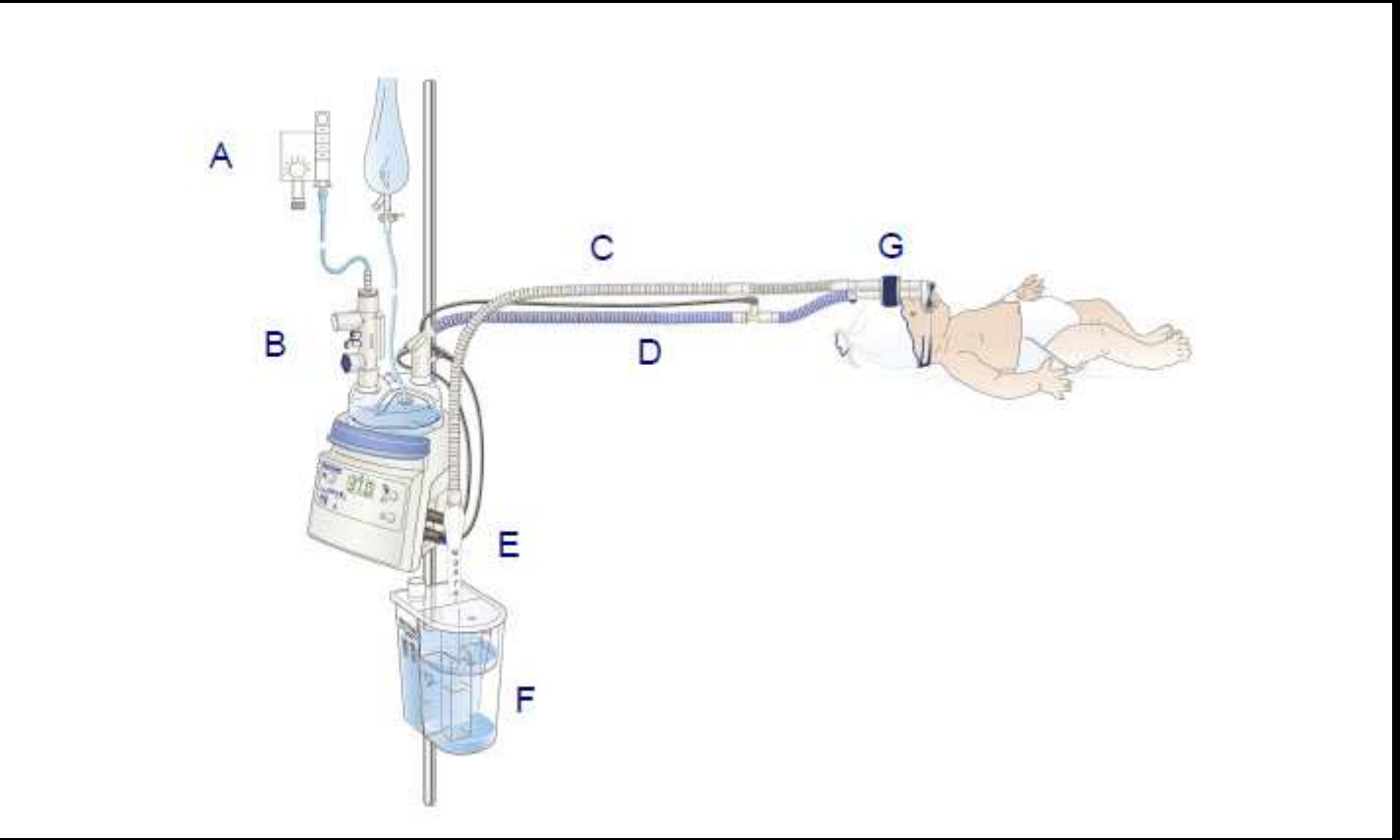
Grande variabilité inter patients

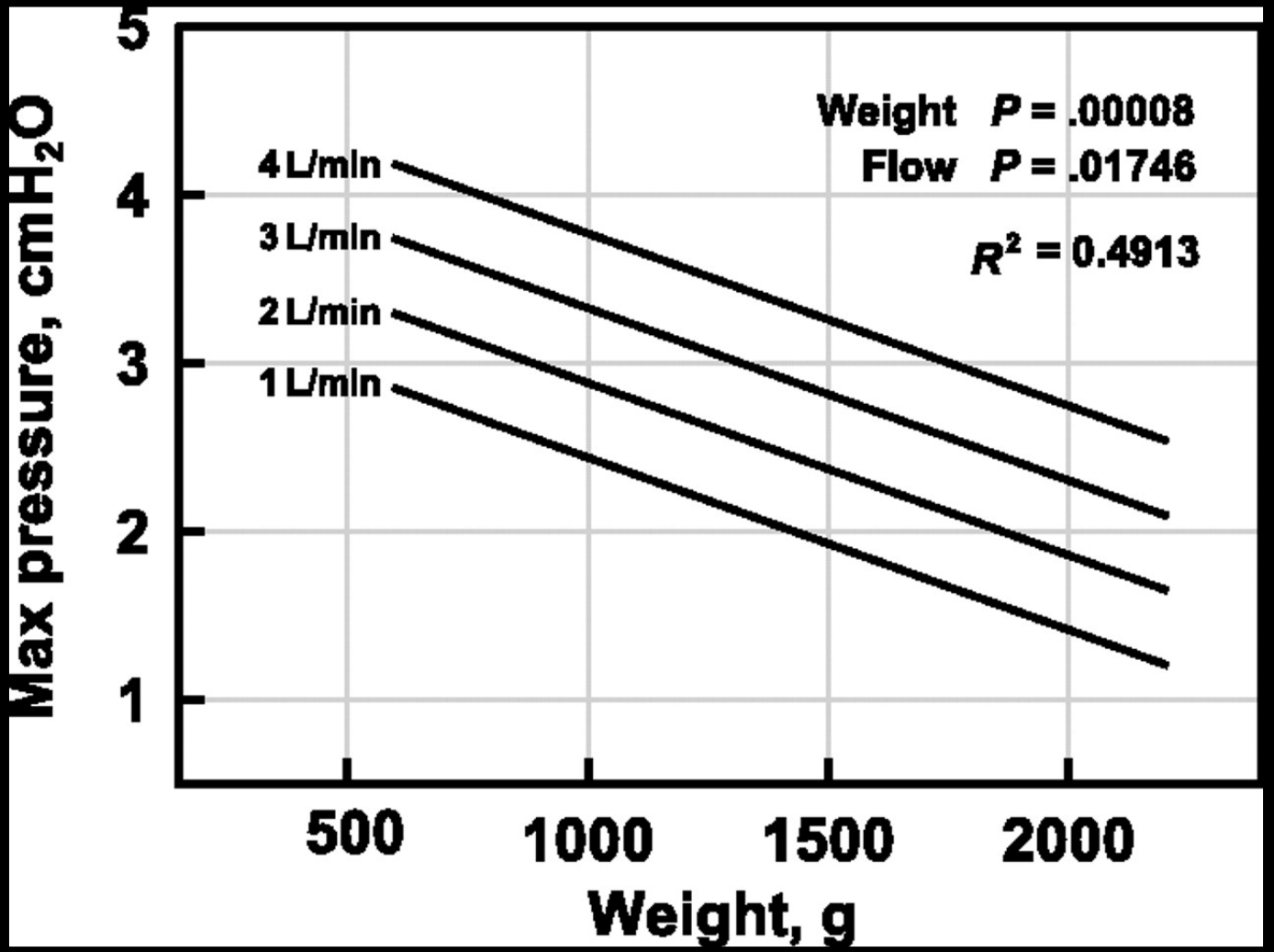
- -1,54 à 5,34 cm H_2O, bouche fermée
- -Fuites nasales
- -Anatomie

Parke R, BJA, 2009, august 18

Oxygénothérapie nasale à « haut débit »:

Expérience en **néonatologie**





Kubicka, Pediatrics, 2008, 121, 1

Oxygénothérapie nasale à « haut débit »:

Expérience en **néonatologie**

-positive pressure

-flow rate
-weight (< 1500 gr)
-nasal leaks
-mouth closed !

-no pressure-limiting capabilities…

« *larger cannulae can generate unsafe level of CPAP* »

Kubicka, Pediatrics, 2008, 121, 1

Oxygénothérapie nasale à « haut débit »:

Expérience en **néonatologie**

« *If the nasal leak is eliminated with the use of a cannula that obstructs the nares completely, then dangerously high levels of distending pressure could be generated during periods when the mouth is closed, because there is no effective « pop-off » available* »

Kubicka, Pediatrics, 2008, 121, 1

Oxygénothérapie nasale à « haut » débit:

Expérience en **néonatologie**

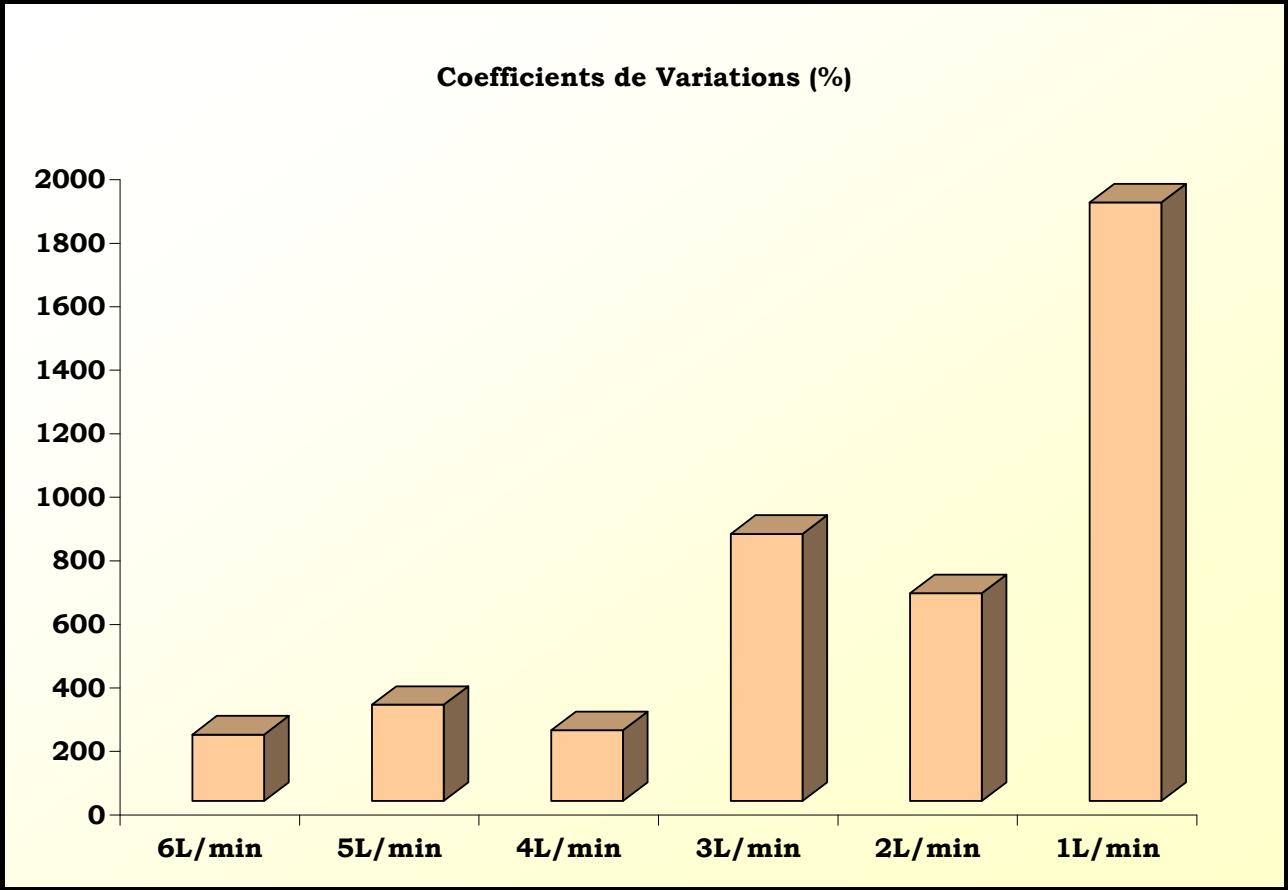
Uncontrolled and Unpredictable CPAP to infants

large nares
mouth leak

Hasan, Ped Crit Care Med, 2010, march

Oxygénothérapie nasale à « haut » débit:

Expérience en **néonatologie**



Lampland, J Pediatr, 2009, 154, 177

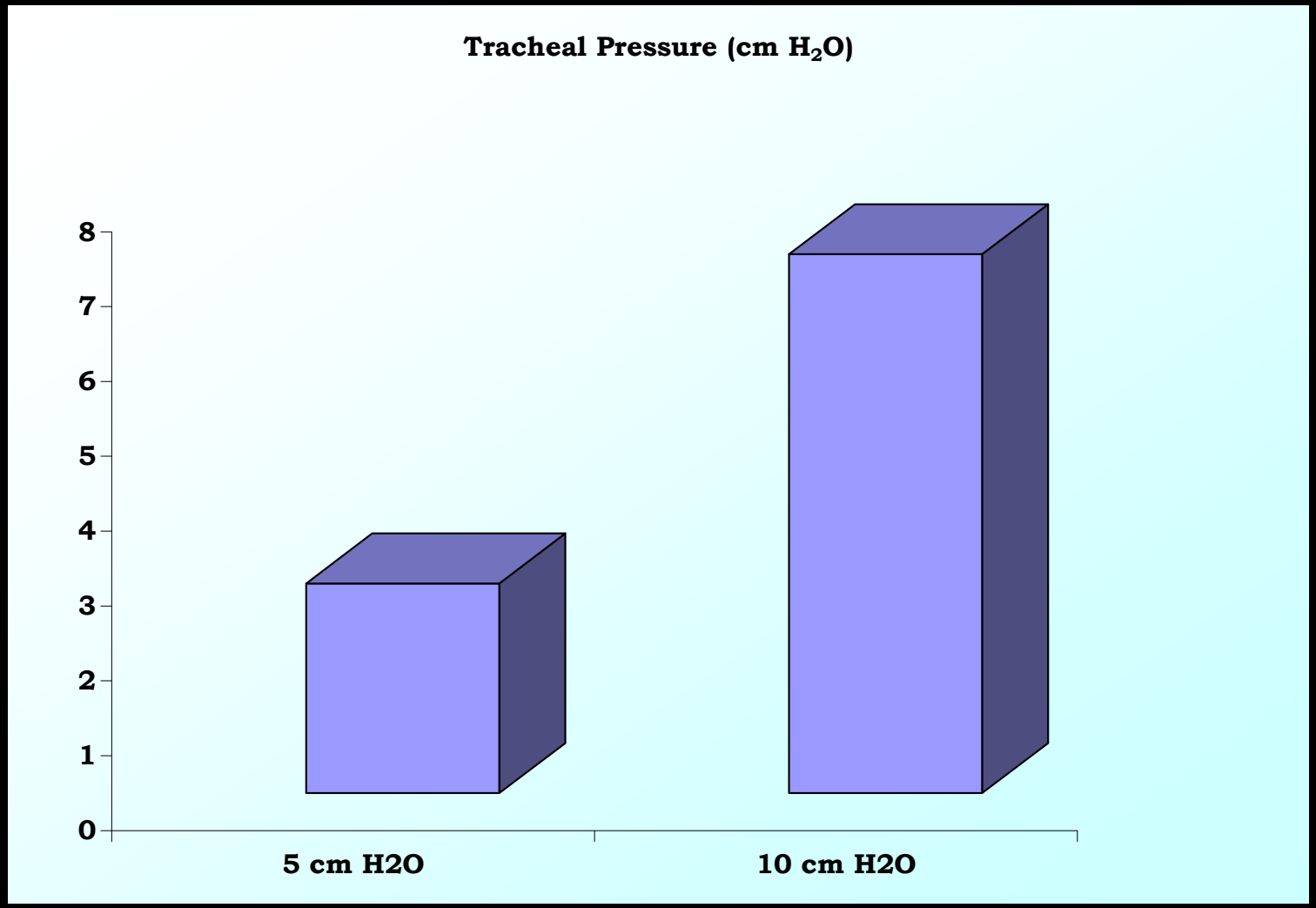
Oxygénothérapie nasale à « haut » débit:

Expérience en **néonatologie**

« *heated, humidified high-flow nasal cannula should not be used as a replacement for delivering CPAP*»

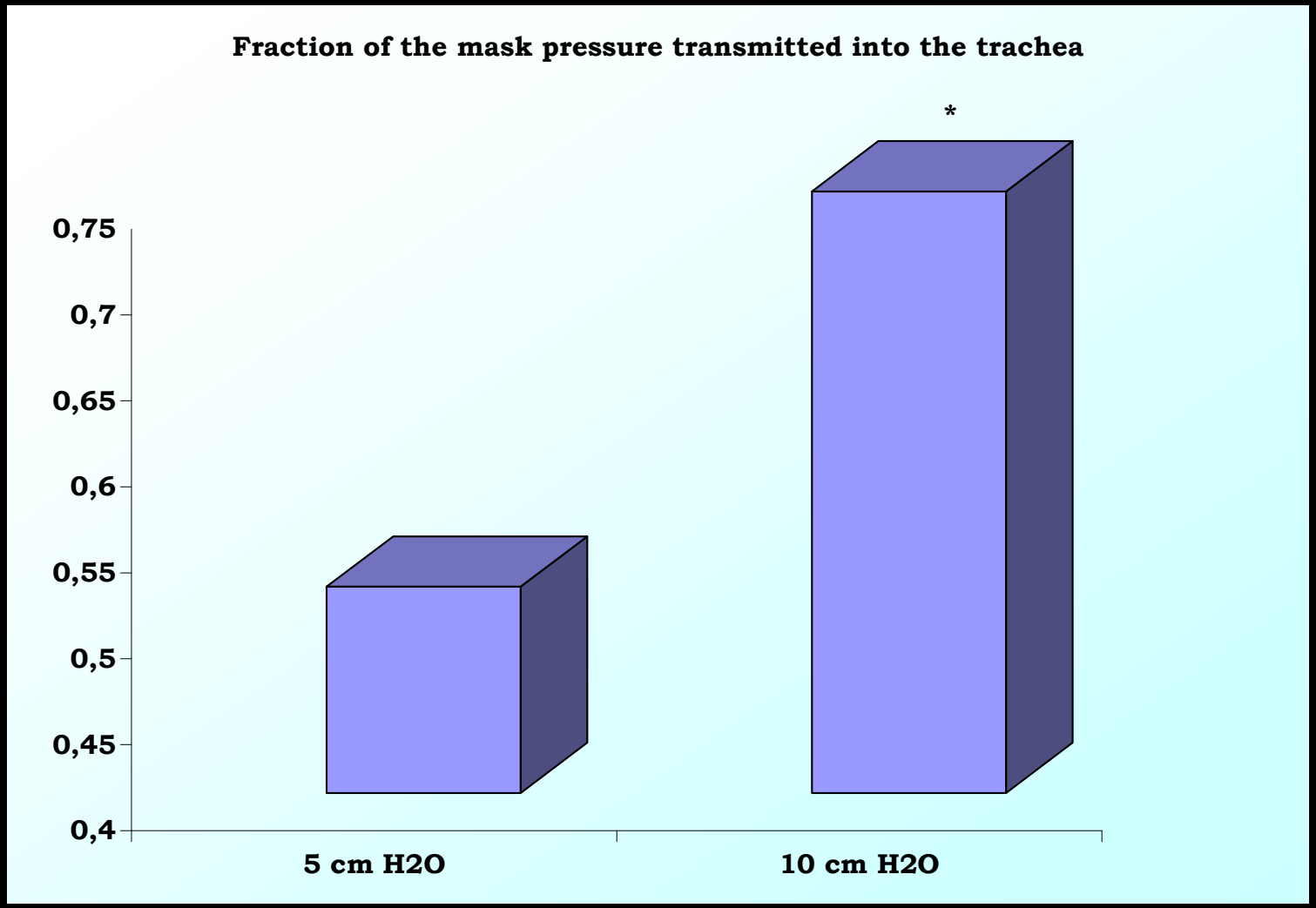
Kubicka, Pediatrics, 2008, 121, 1

Pressure transmission into the trachea ?



Kindgen-Milles, Acta Anaesth Scand, 2002, 46, 860

Pressure transmission into the trachea ?



Kindgen-Milles, Acta Anaesth Scand, 2002, 46, 860

Pressure transmission into the trachea ?
WHY ?

-Forward movement of the soft palate to the back of the tongue
-Blockage of the oral escape route
-Direction of airflow into the respiratory tract

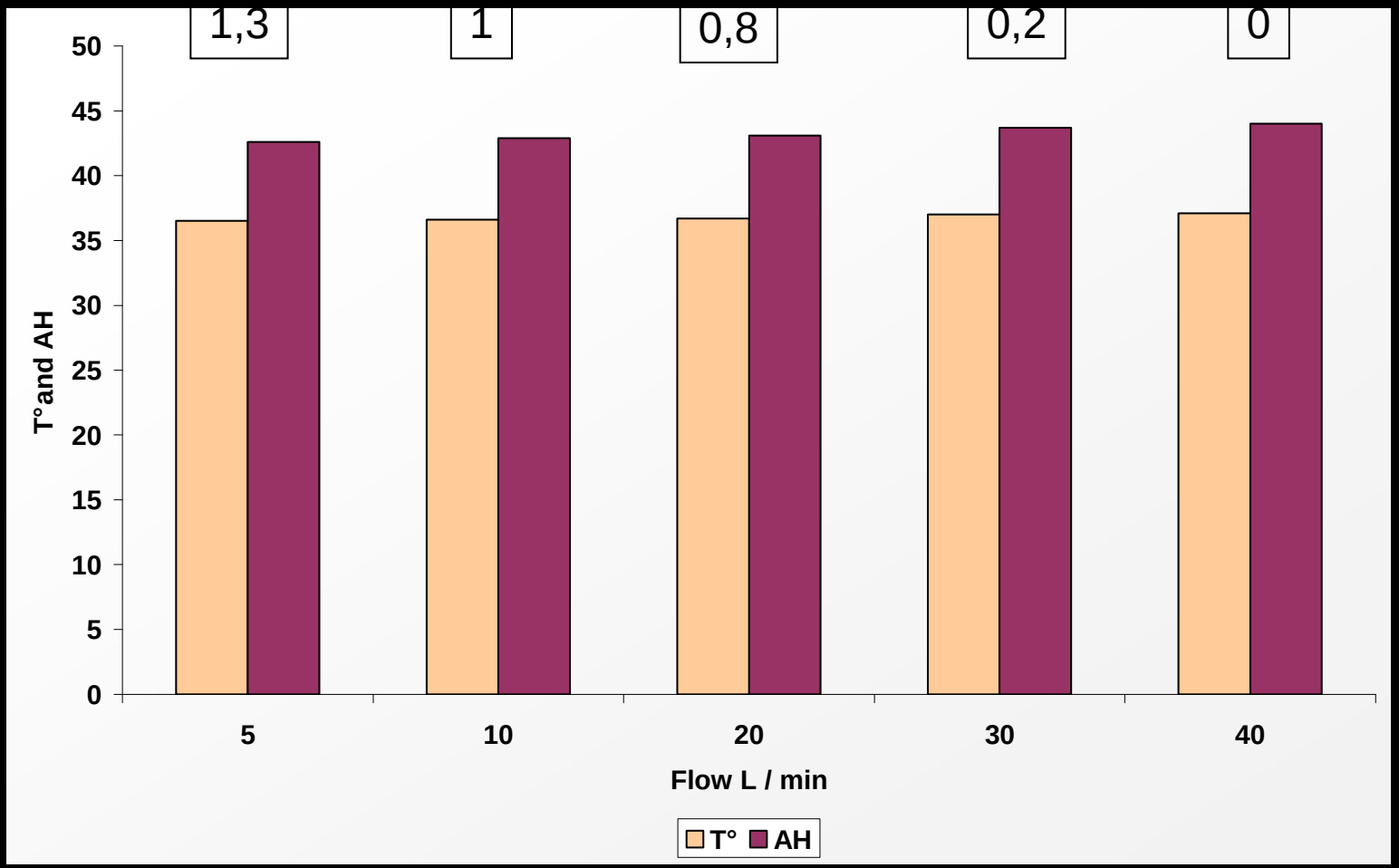
Kindgen-Milles, Acta Anaesth Scand, 2002, 46, 860

Nasal High Flow
Importance of ***humidification***

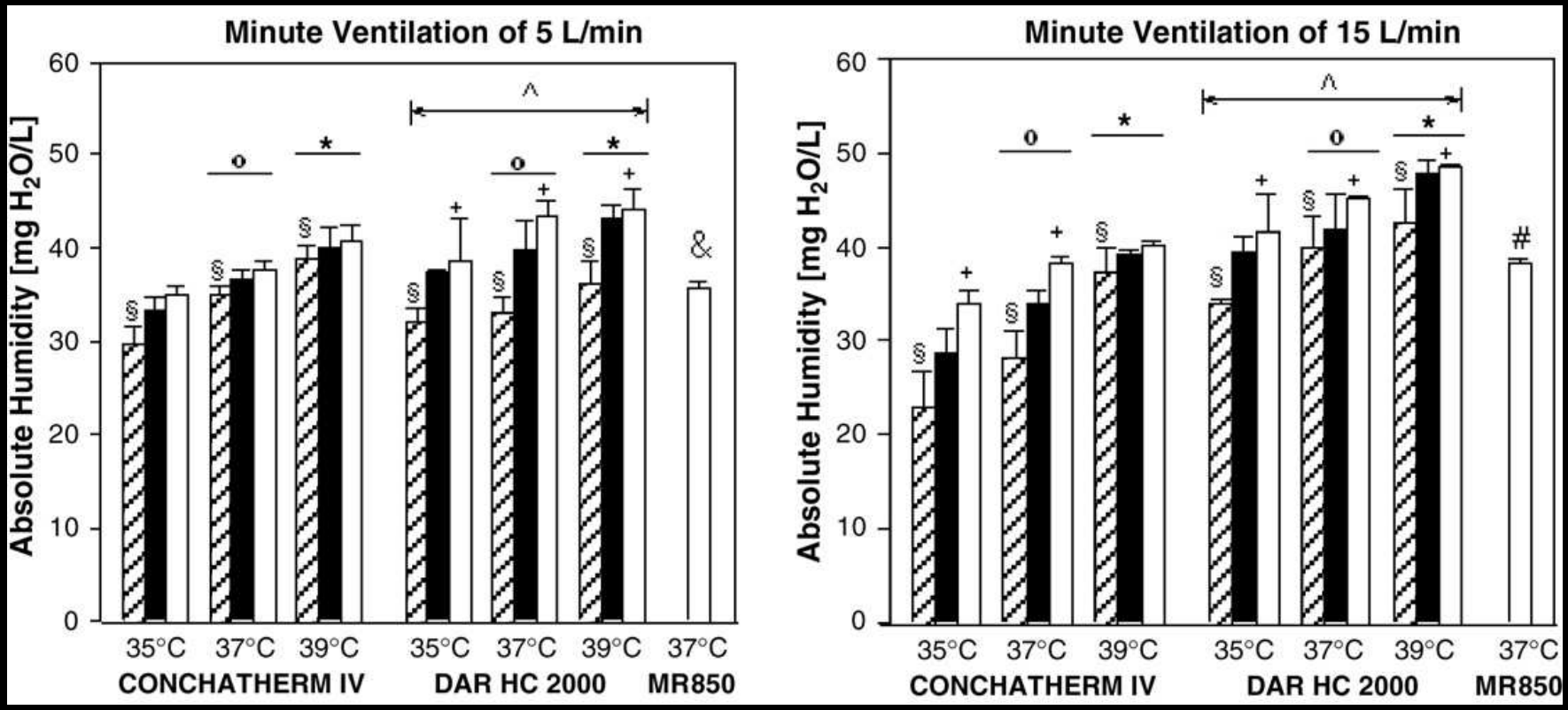
Sécheresse
Inconfort
Congestion (résistance)
Epistaxis
Résistance des voies aériennes
Compliance au traitement

De Araujo, Chest, 2000, 117, 142

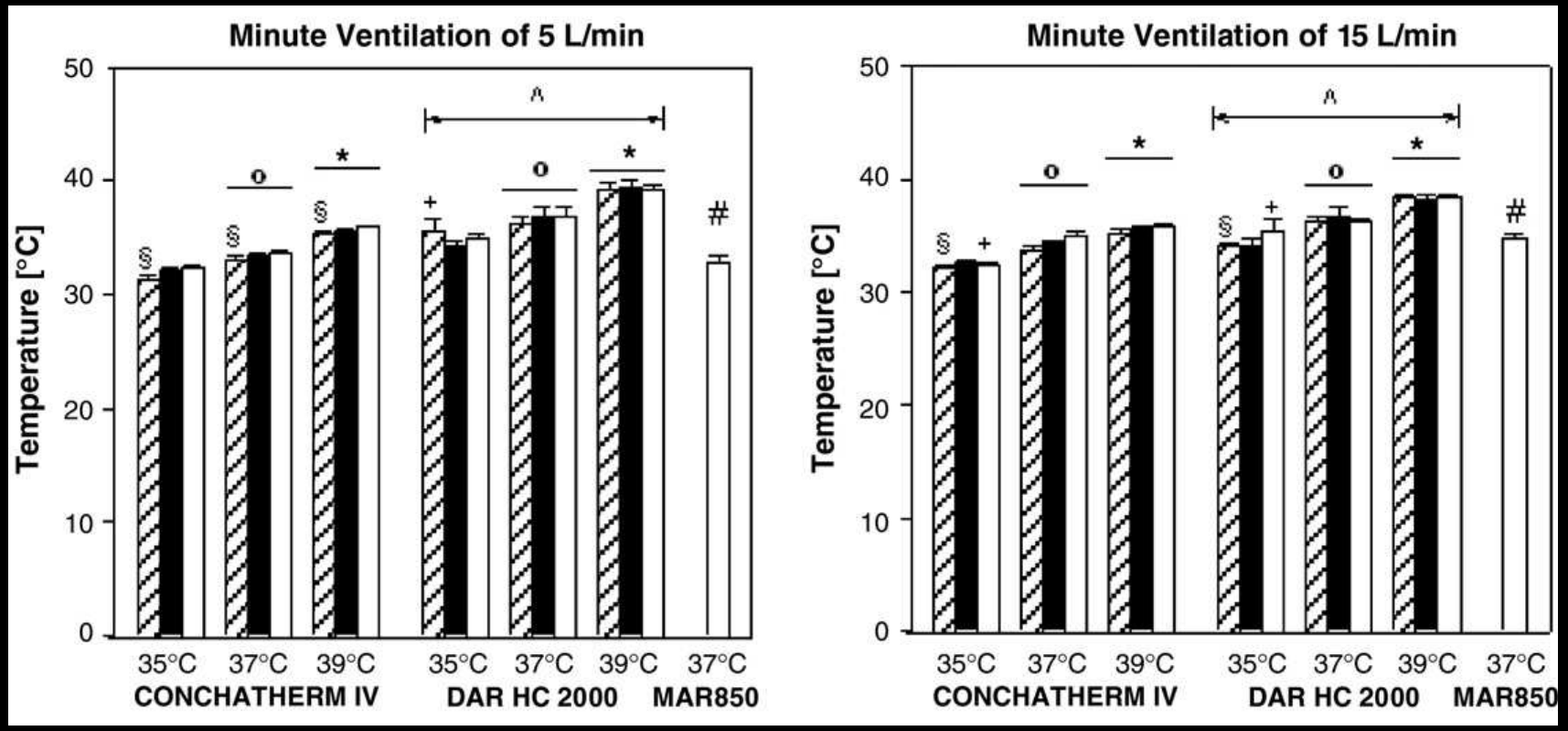
Nasal High Flow BTPS Gas
Performance of the Vapotherm 2000i humidifier
Water difference from BTPS



Waught, Resp Care, 2004, 49, 902



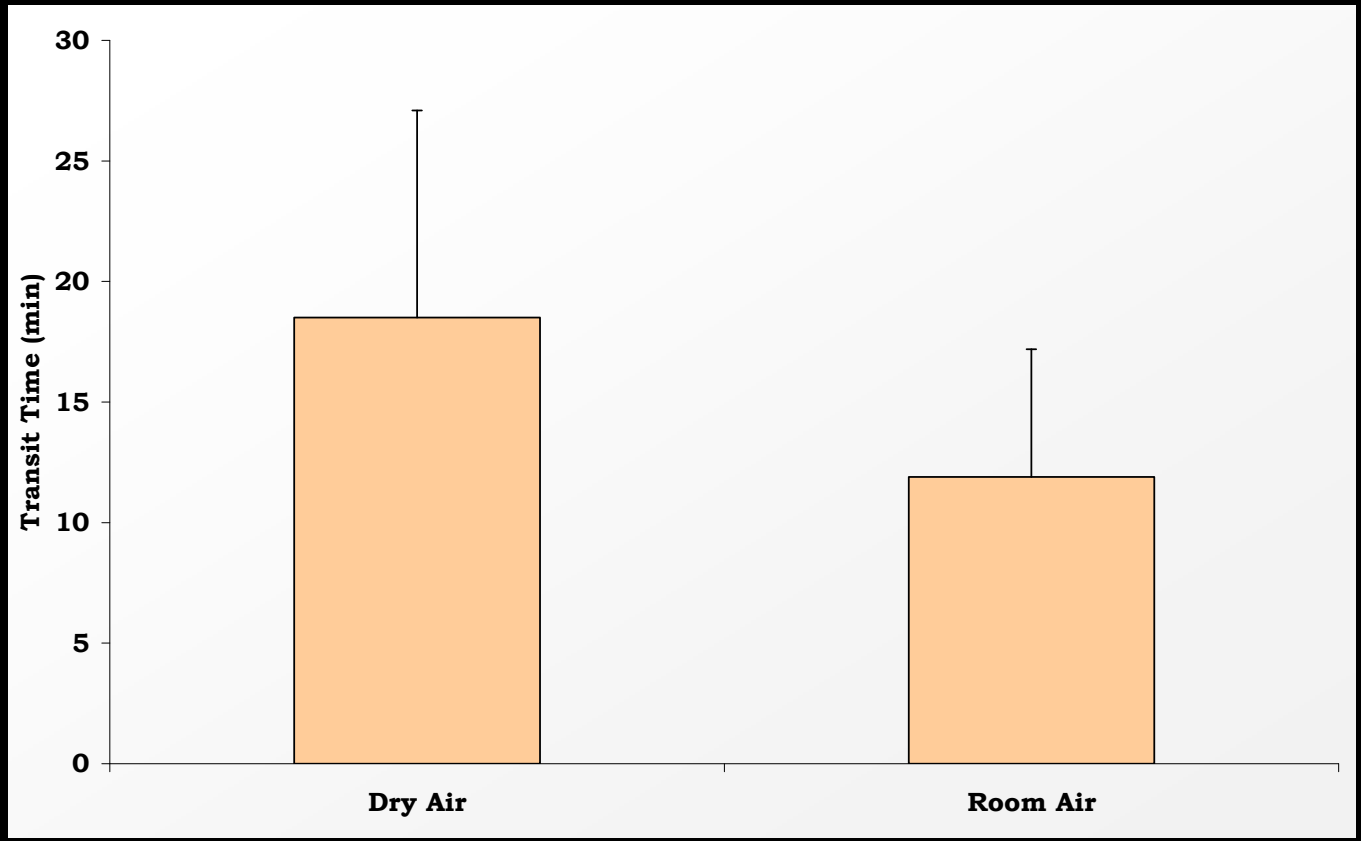
Pelosi, J Crit Care, 2007, 22, 258



Pelosi, J Crit Care, 2007, 22, 258

Nasal High Flow
Importance of humidification

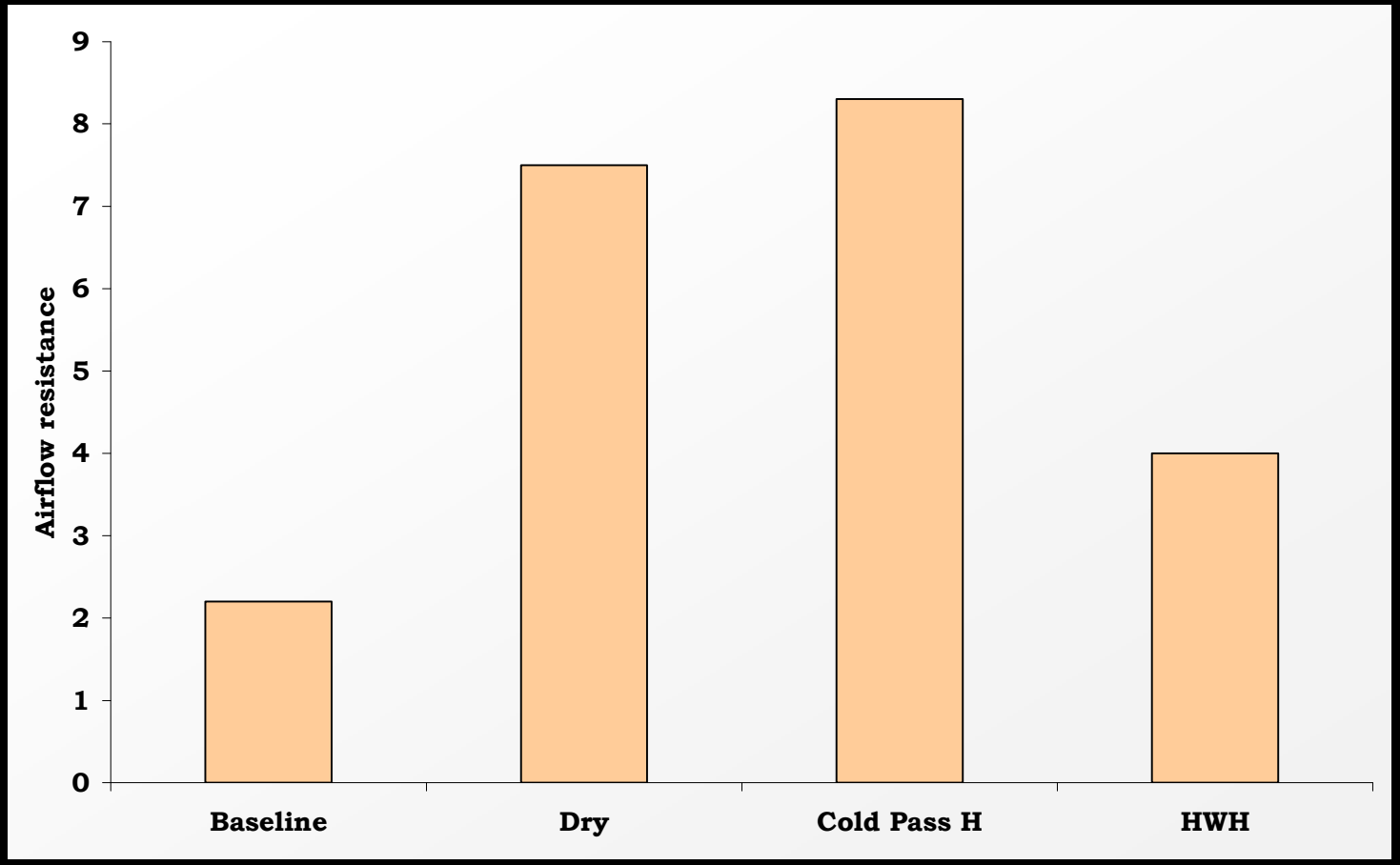
Saccharin Nasal Transit Time



Salah B, Eur Resp J, 1988, 1, 852

Nasal High Flow
Importance of humidification

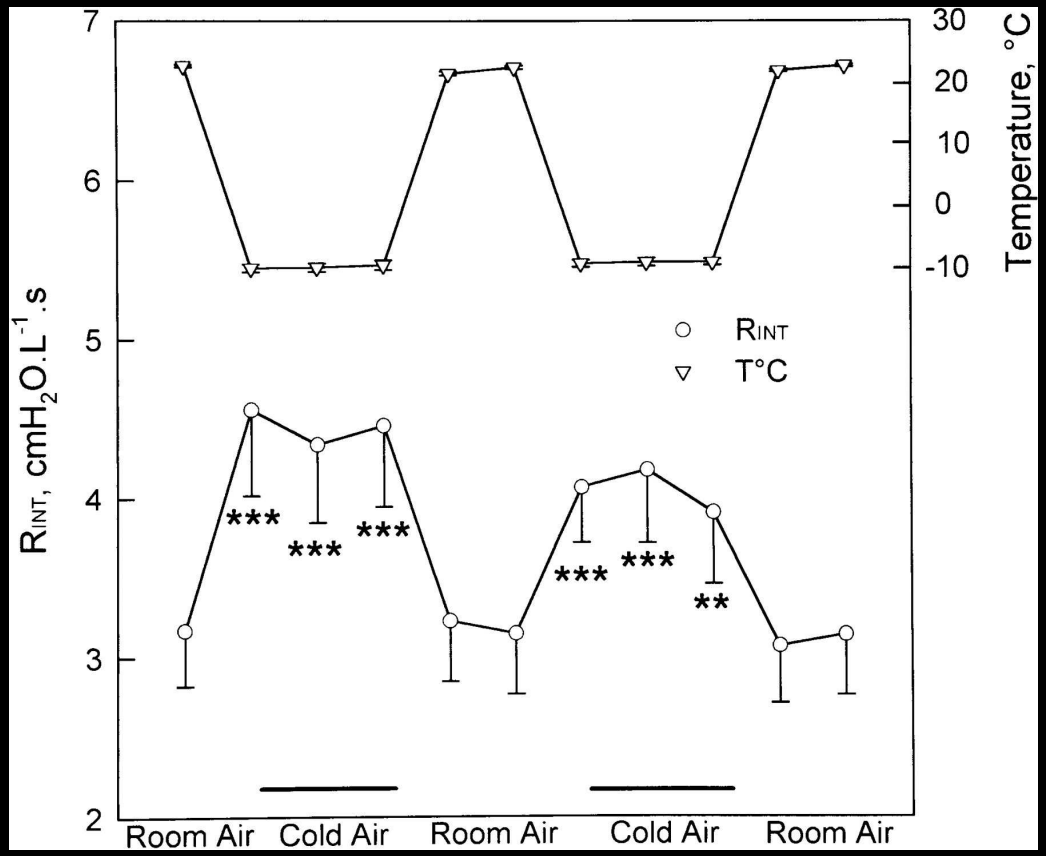
Nasal Airflow Resistance



Richards, AJRCCM, 1996, 154, 182

Nasal High Flow
Importance of humidification

Bronchial Airflow Resistance

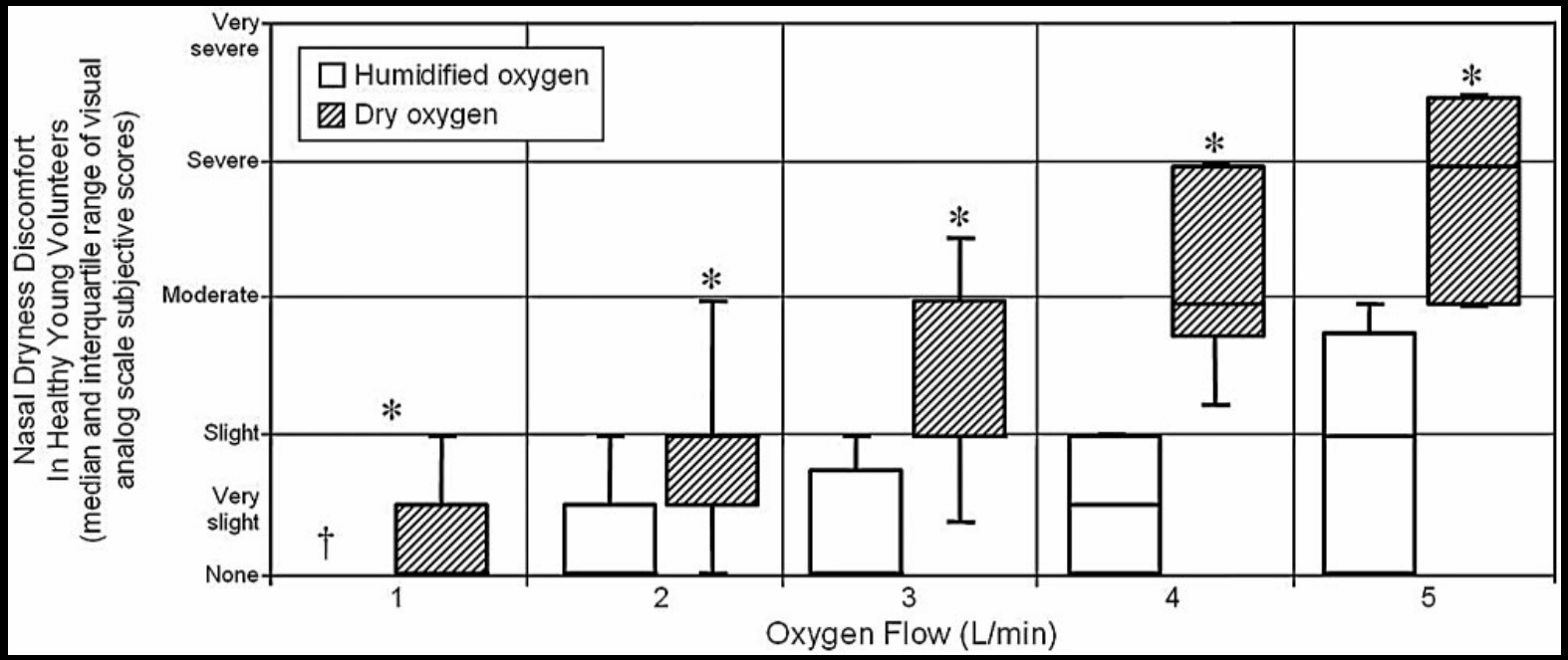


Fontanari, JAP, 1996, 81, 1739

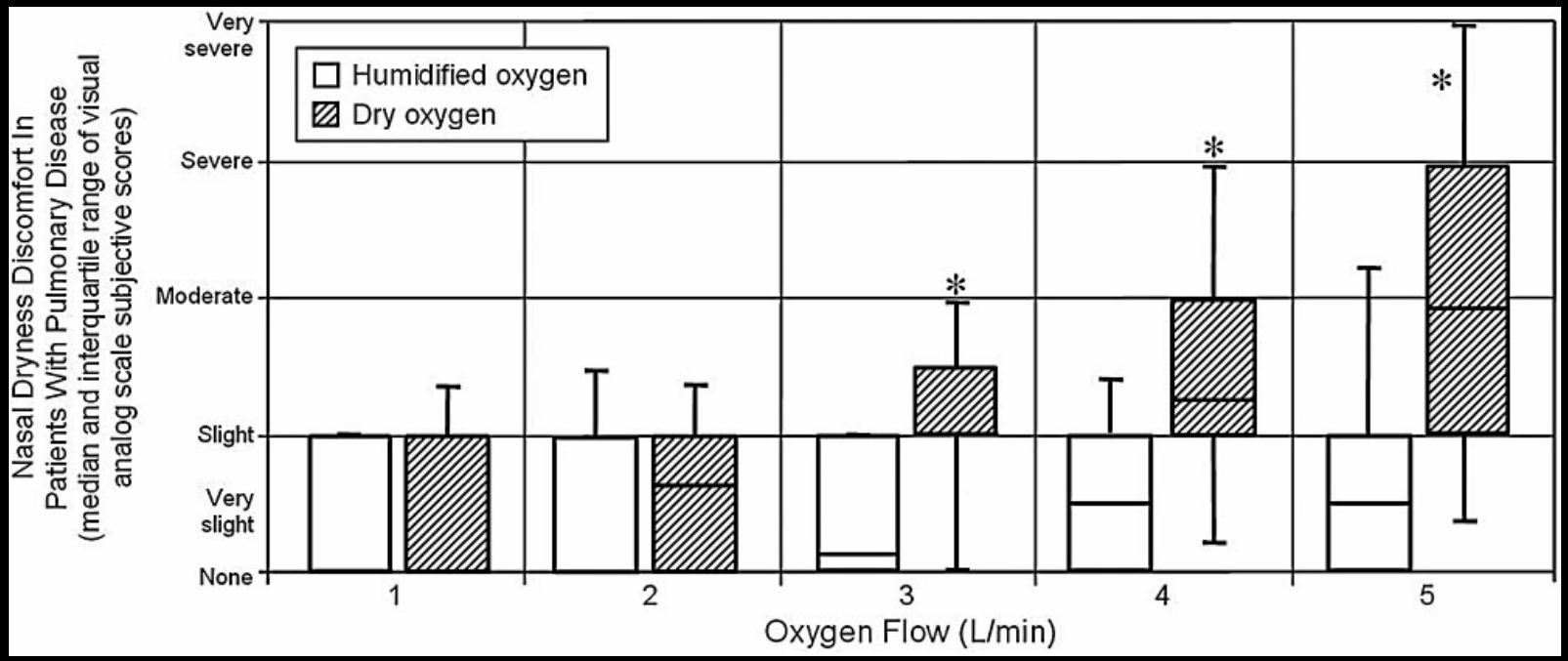
Importance of humidification
Bronchectasis, 20-25 L/min, 3h/day during 6 days

Tracheobronchial clearance / 6 hours	
Baseline	35+/-10%
Humidification	27+/- 9%

Hasani, Chronic Respiratory Disease, 2008, 5, 81

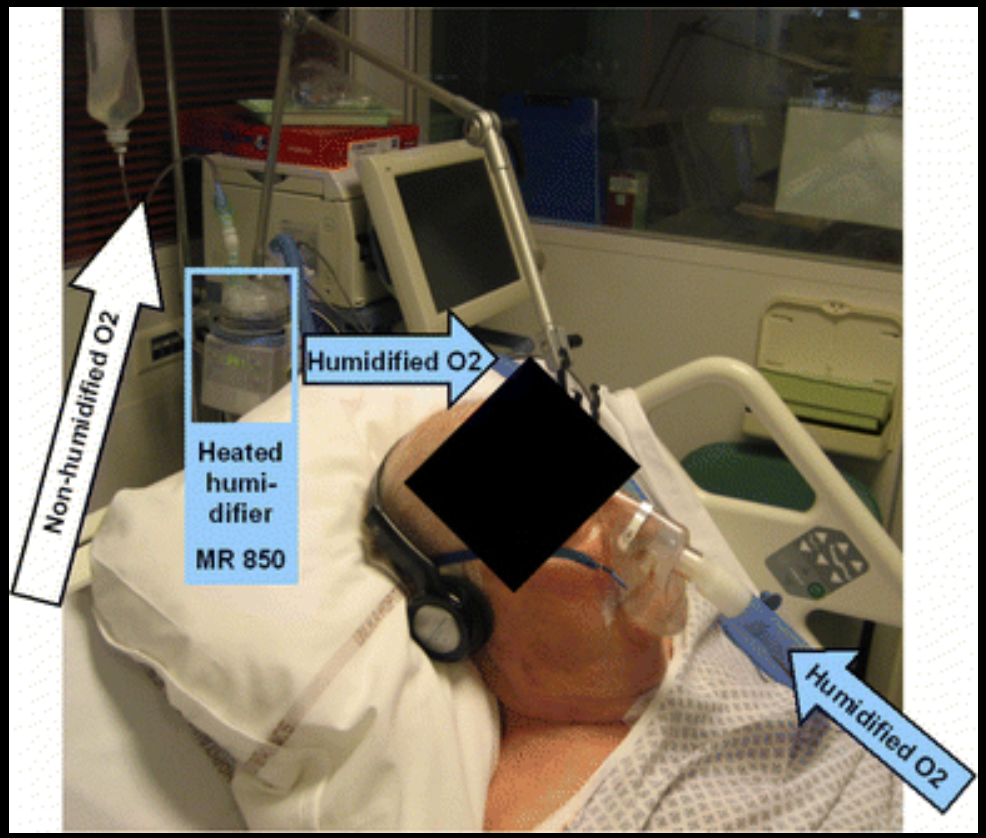


Miyamoto, Resp Care, 2008, 53, 503



Miyamoto, Resp Care, 2008, 53, 503

Importance of humidification
Face mask, 3 to 15 L/min, BH vs HH
Discomfort ? Dryness ?



Chanques, ICM, 2009, 35, 996

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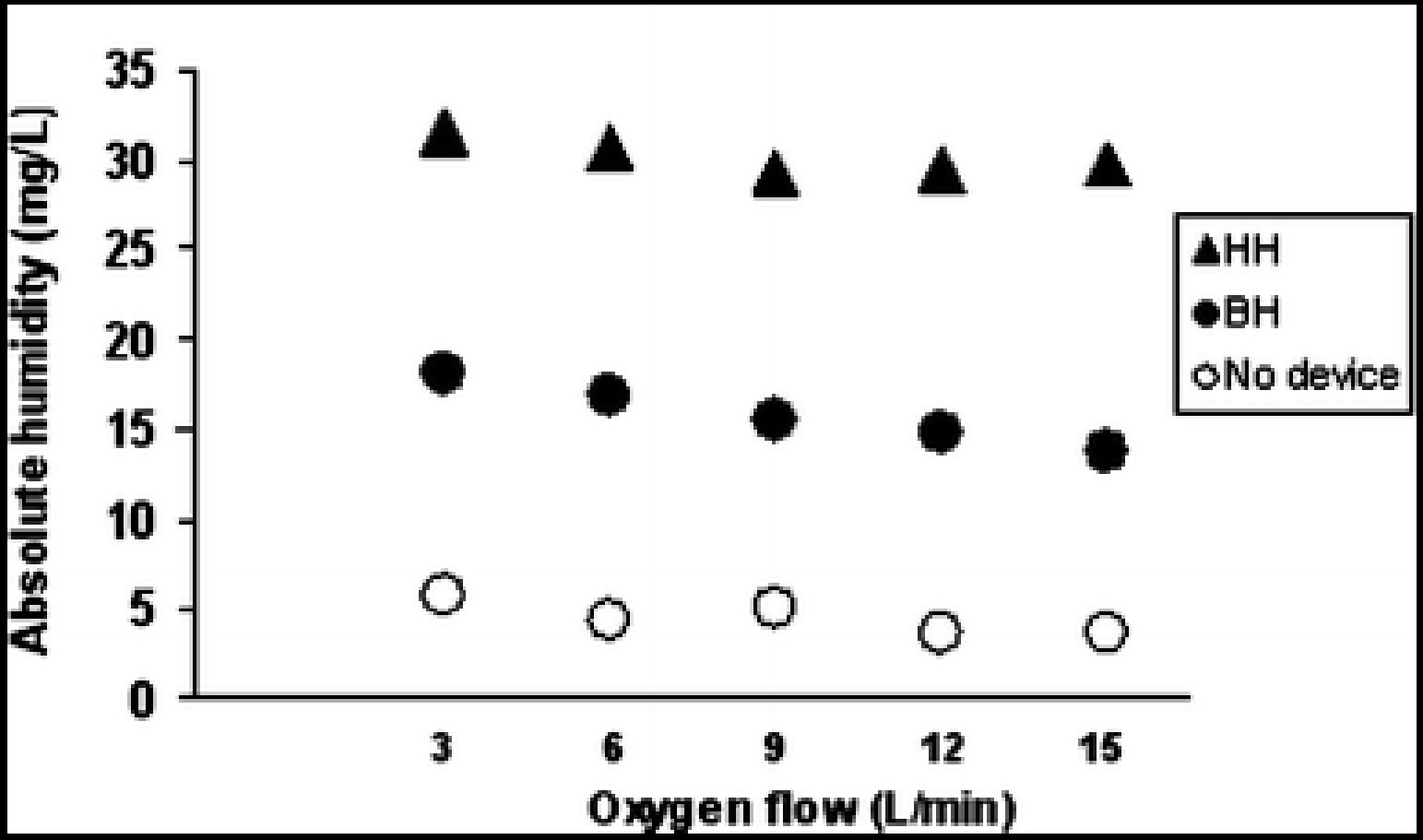

Chanques, ICM, 2009, 35, 996

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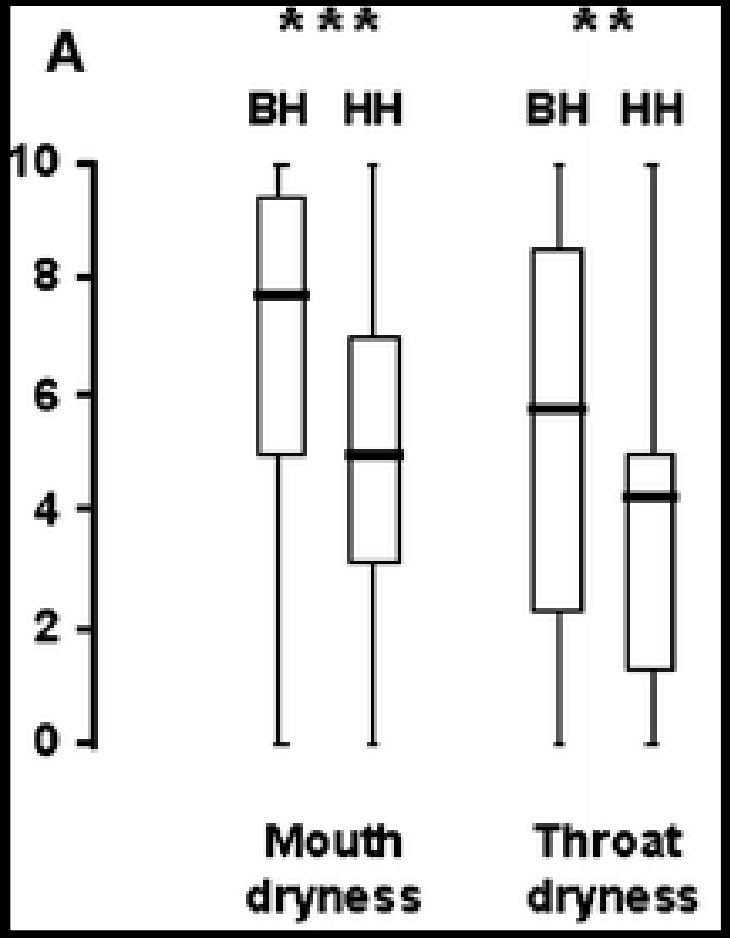

Chanques, ICM, 2009, 35, 996

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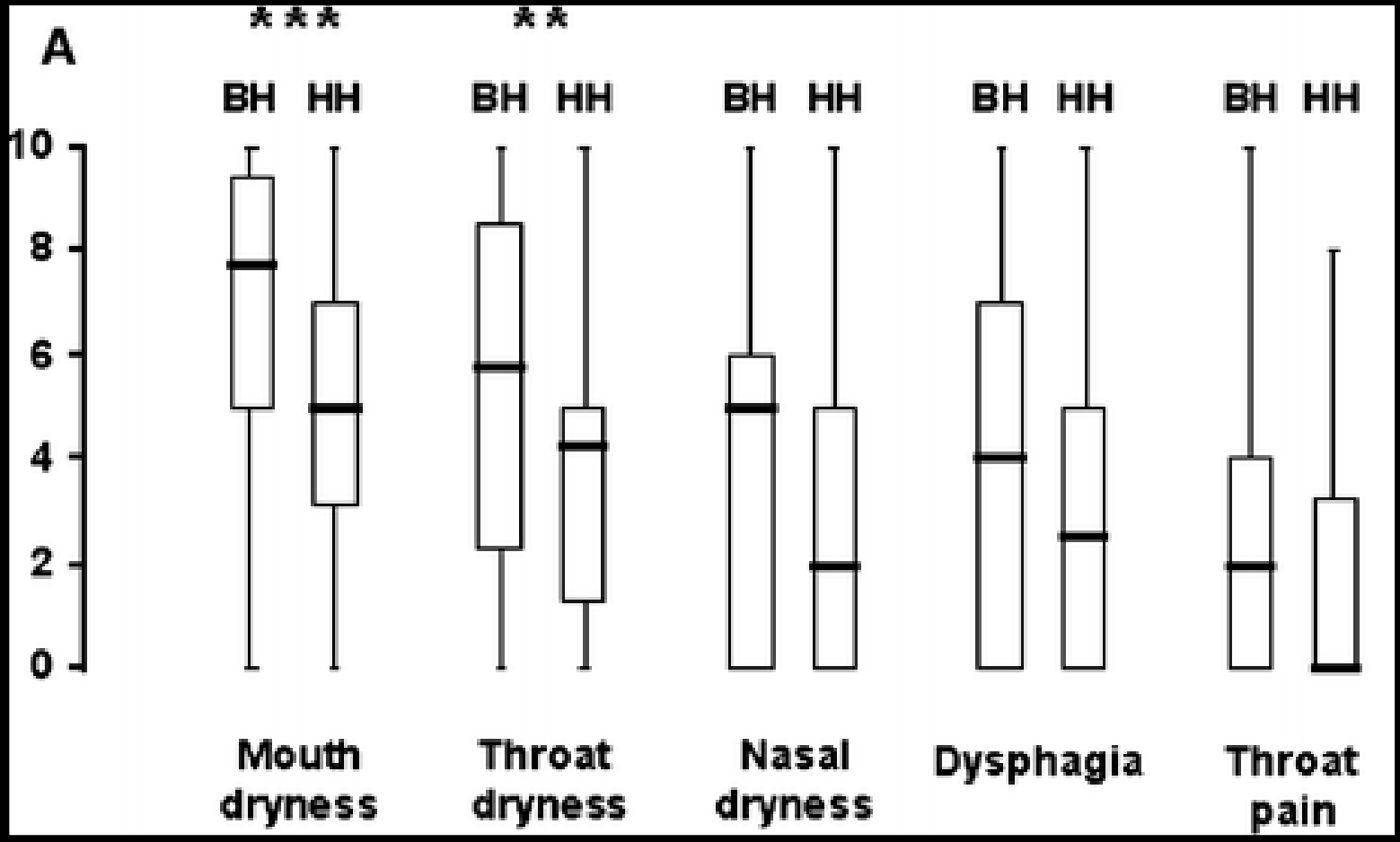
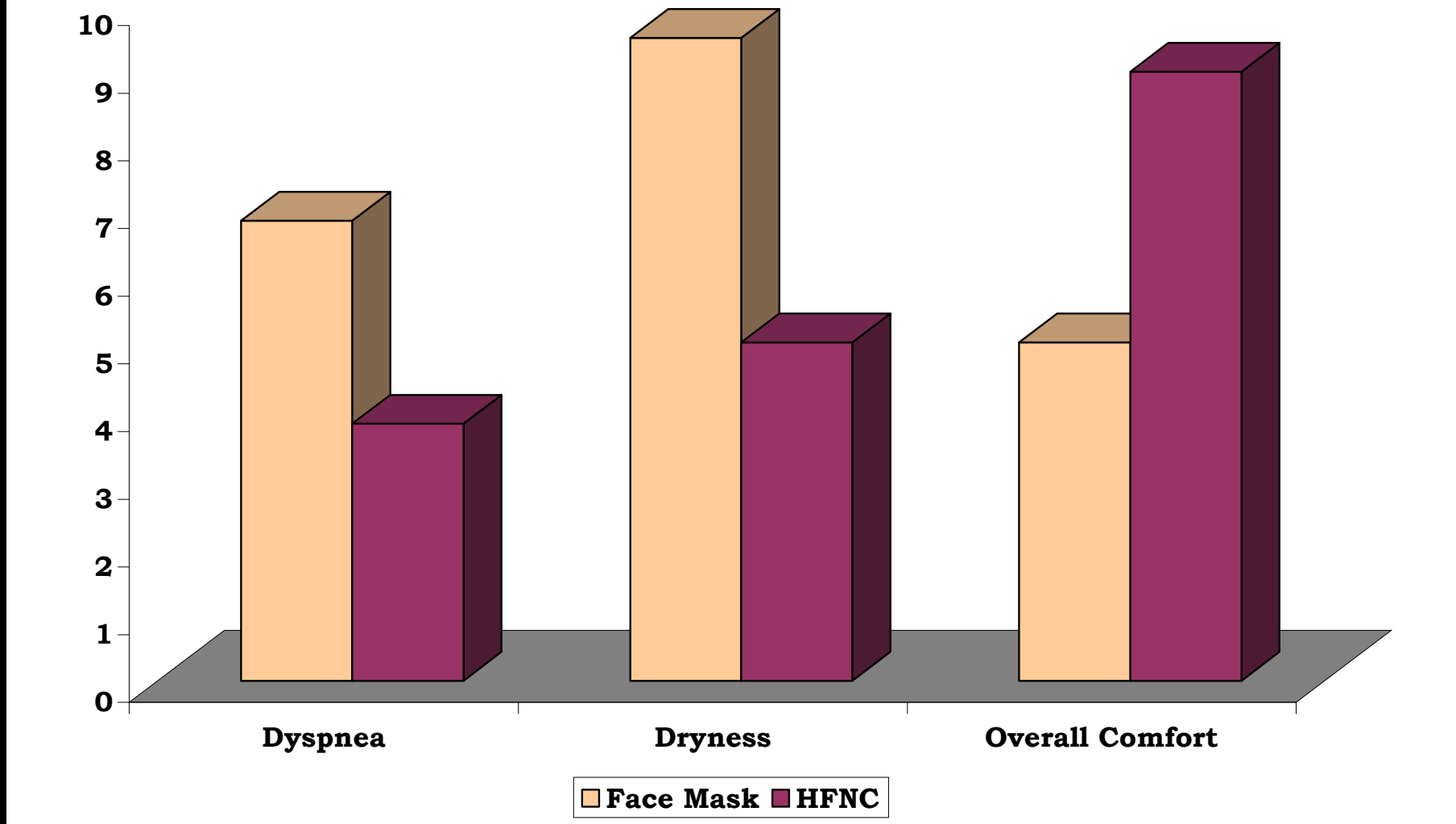
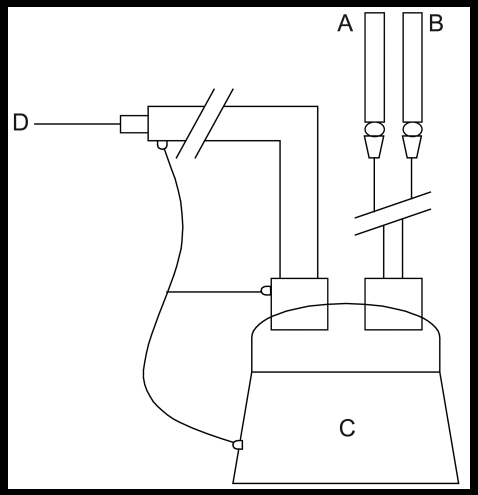
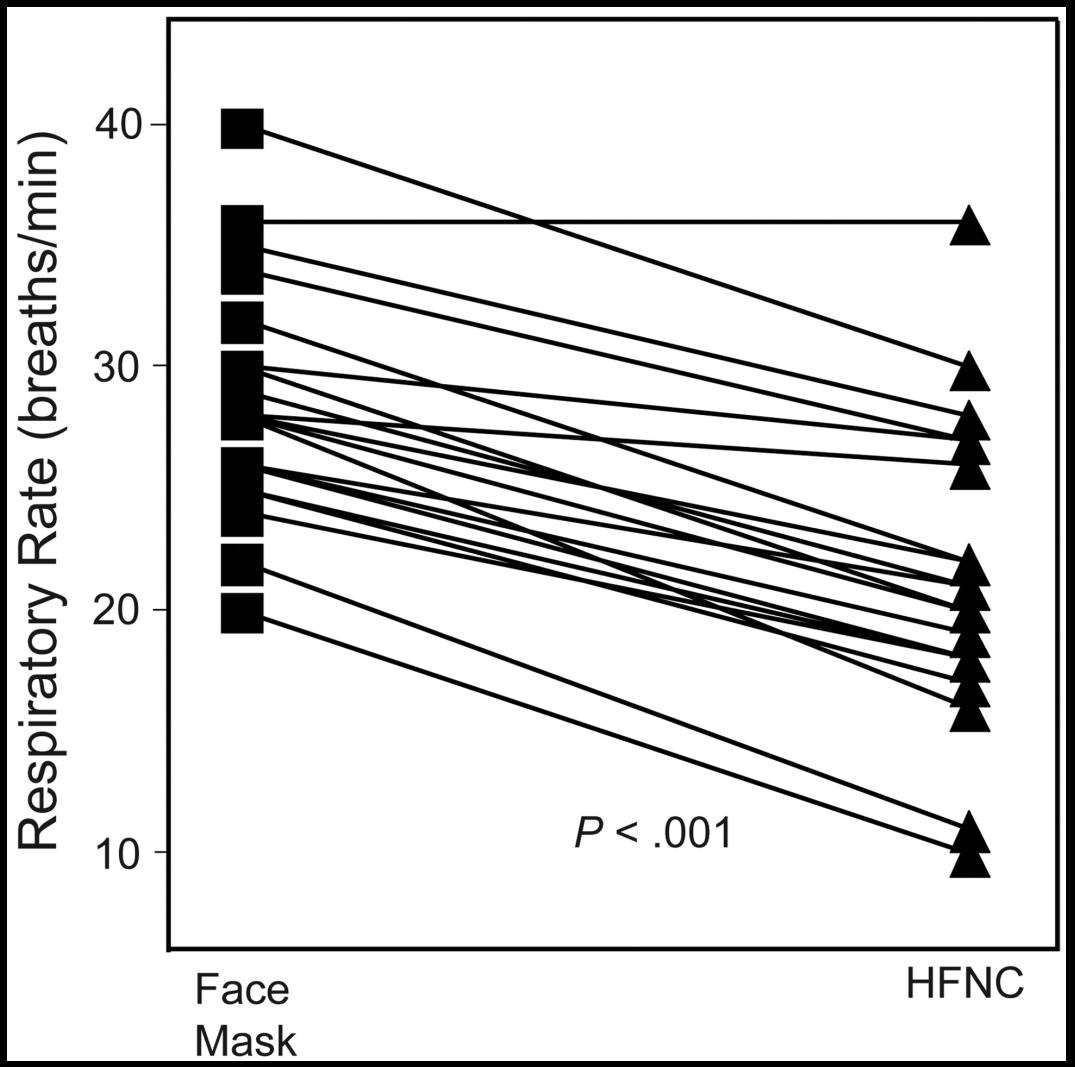


Chanques, ICM, 2009, 35, 996



Roca, Respir Care, April 2010, 55, 408





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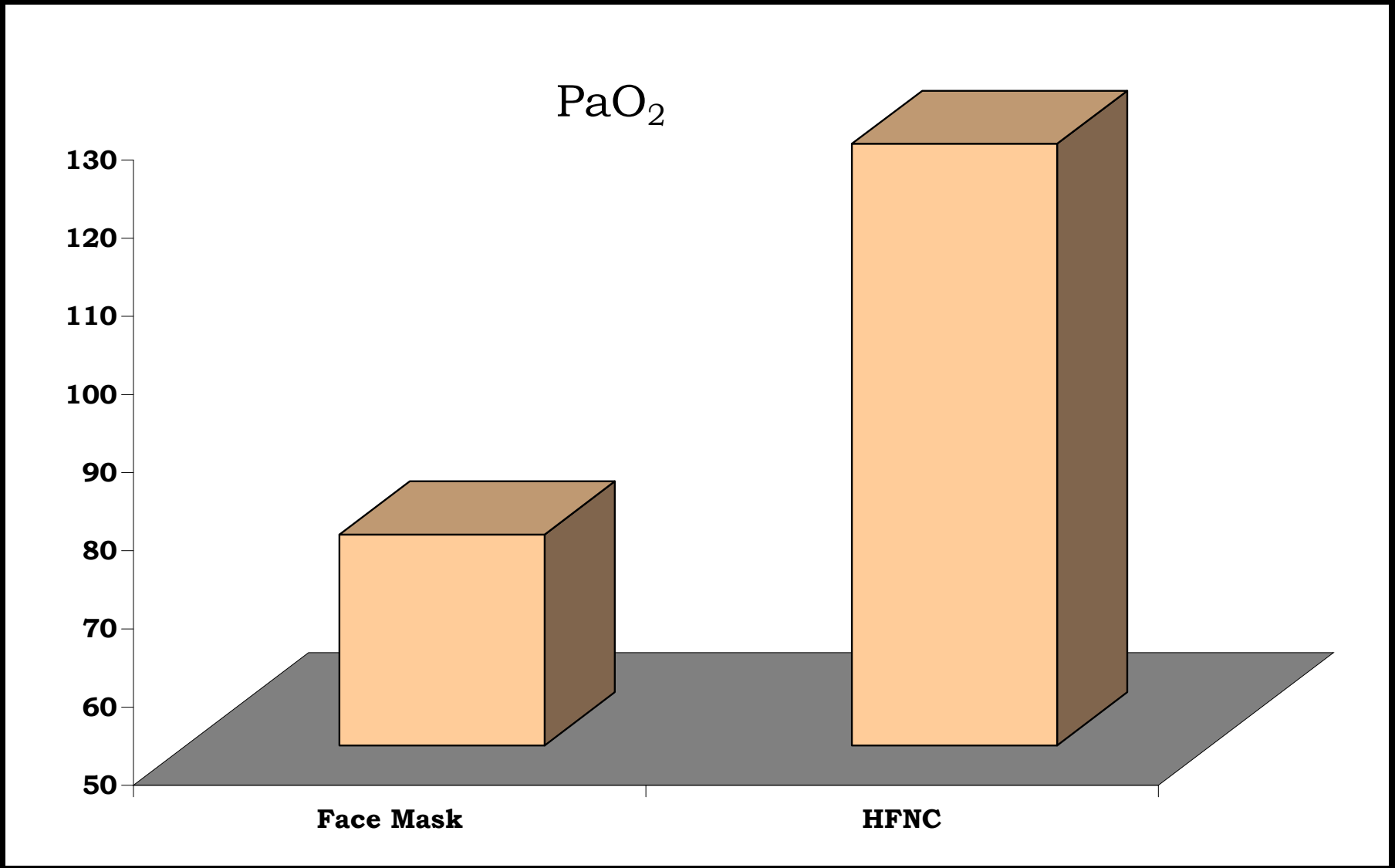
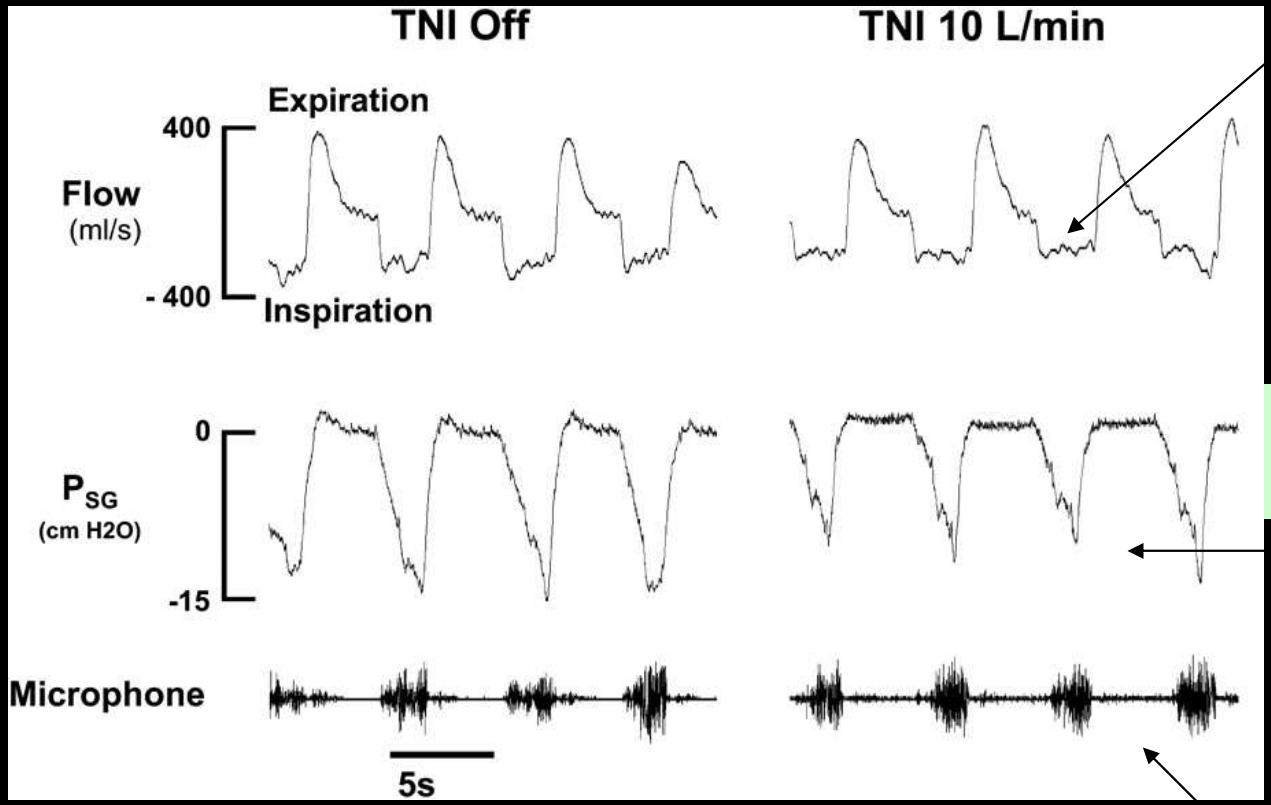


Roca, Respir Care, April 2010, 55, 408

McGinley, AJRCCM, 2007, 176

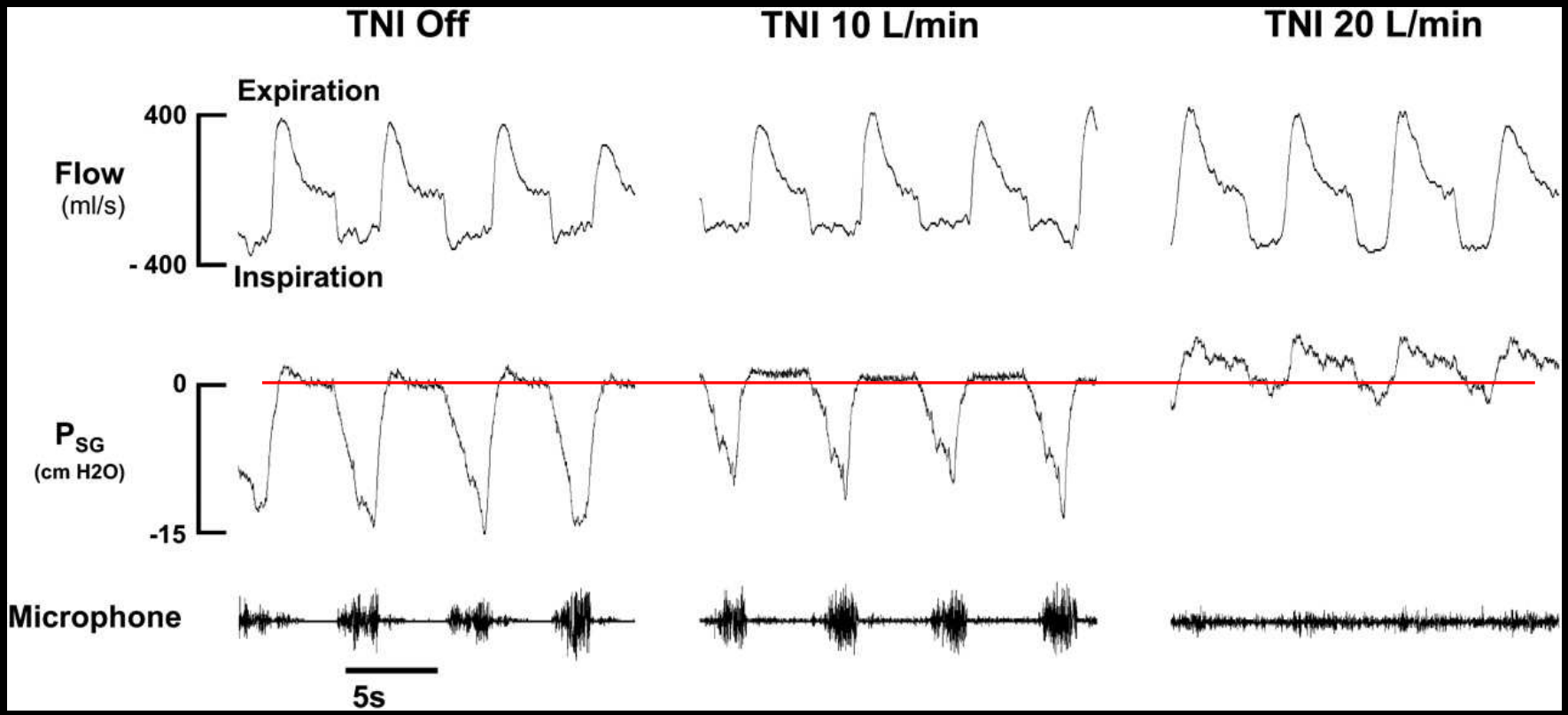
Inspiratory flow limitation



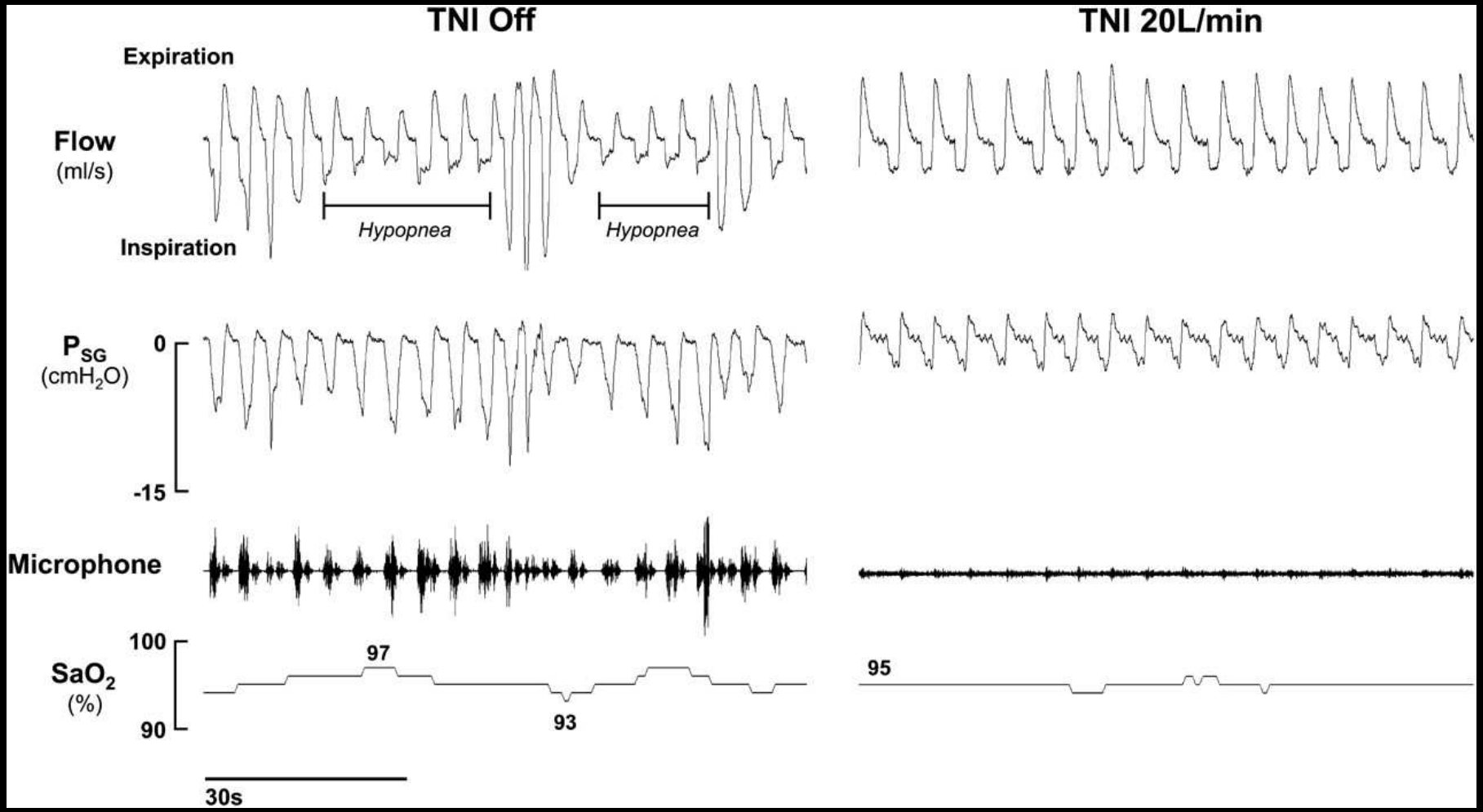
Increased EE P_{SG}
Decreased Swing

Snoring

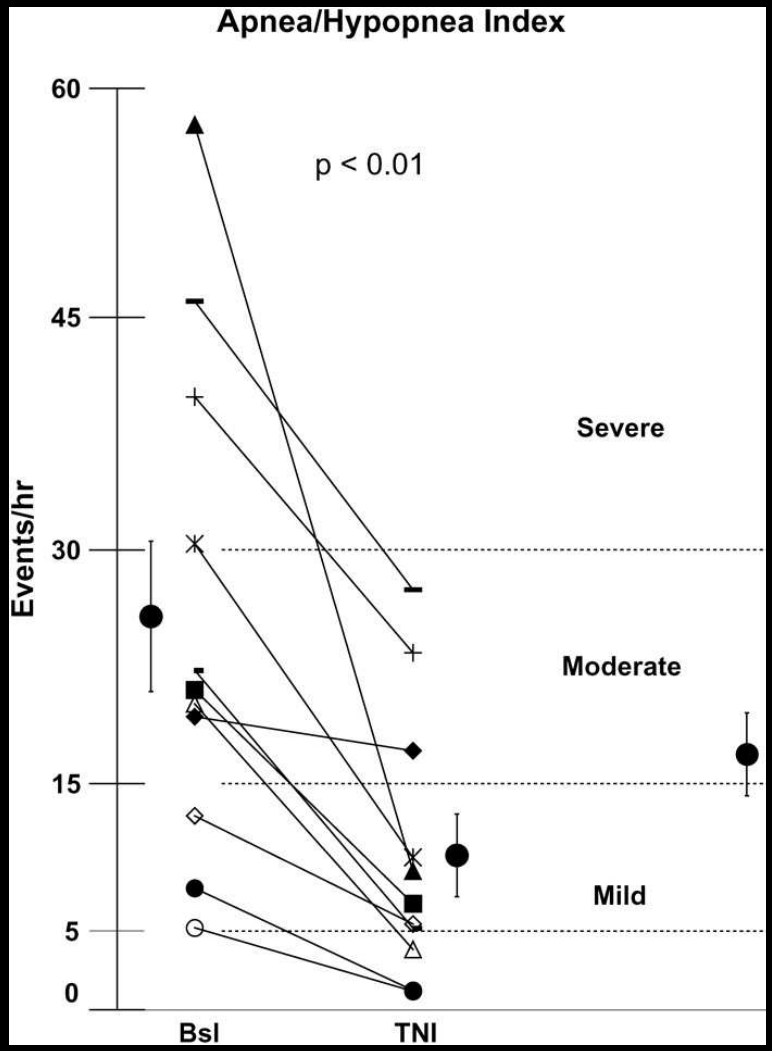
McGinley, AJRCCM, 2007, 176



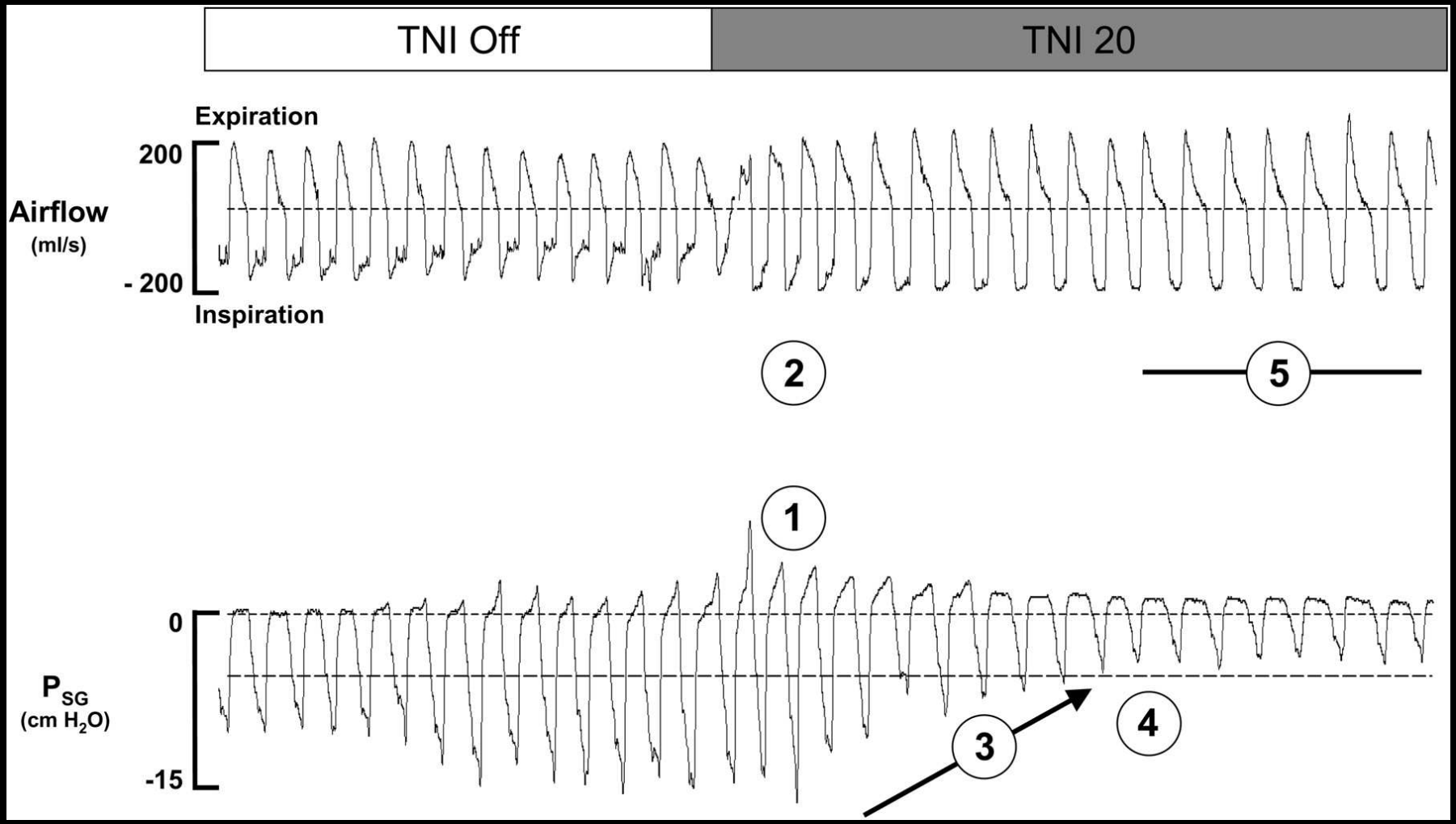
McGinley, AJRCCM, 2007, 176



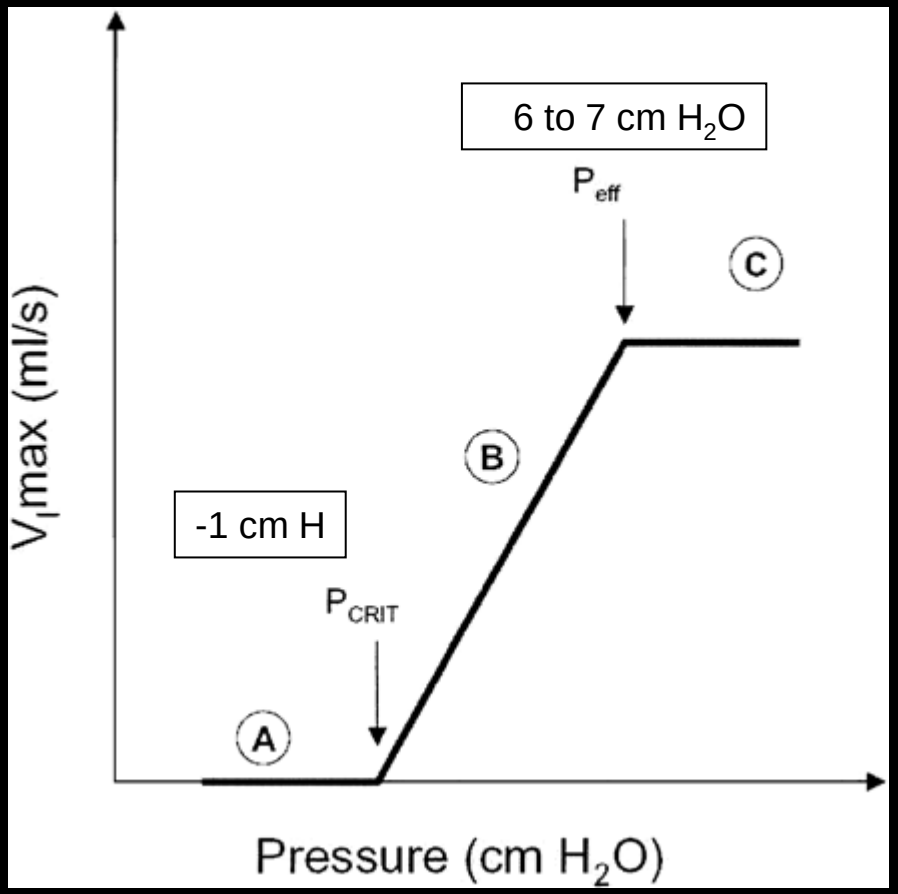
McGinley, AJRCCM, 2007, 176



McGinley, AJRCCM, 2007, 176



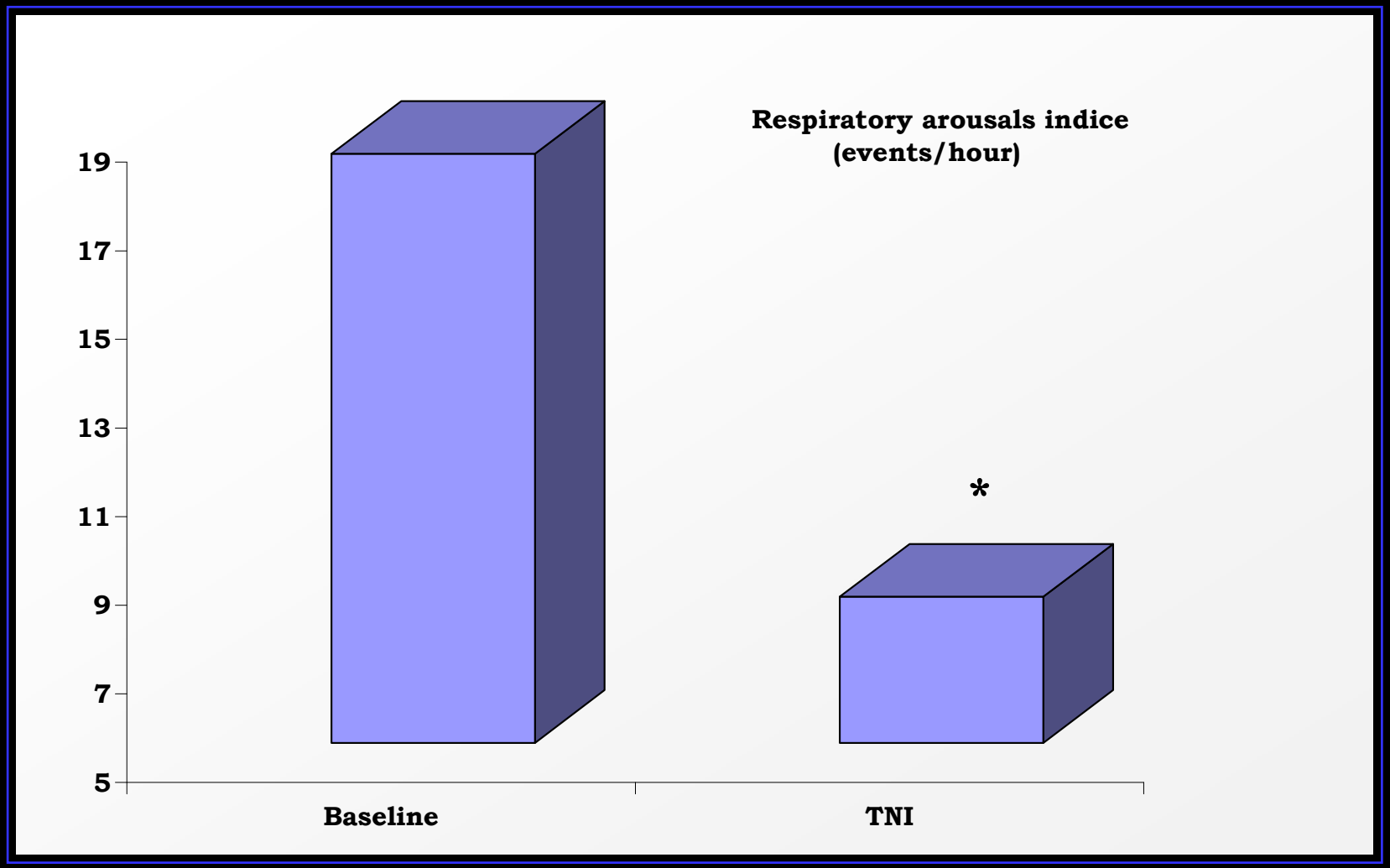
McGinley, AJRCCM, 2007, 176



McGinley, AJRCCM, 2007, 176

High Flow : « TNI » or « *Treatment with nasal insuflation* »

To treat OSA ?



McGinley, AJRCCM, 2007, 176

CCU Patients: a systematic review

8 Abstracts or poster (scientific meetings)
non randomised
4 Vapotherm and 4 Optiflow
HHNC versus standard oxygen therapy
n = 259
Poor quality of data available for analysis

Kercnick J, Austr Crit Care, March, 2010

CCU Patients: a systematic review

- Oxygenation
  - Oxygenation Index
  - Oxygenation Saturation Levels
- Ventilation
  - $PaCO_2$
- Work of Breathing
  - Respiratory Rate
- Positive Airway Pressure
- Patient comfort and compliance
- Reduction in complications

Kercnick J, Austr Crit Care, March, 2010

CCU Patients: a systematic review

Preliminary evidence to support the use of high flow therapy to optimise oxygenation in adults.

? identify the patient population for whom it is most beneficial
? evaluate long-term outcomes
? definitive recommendations for practice

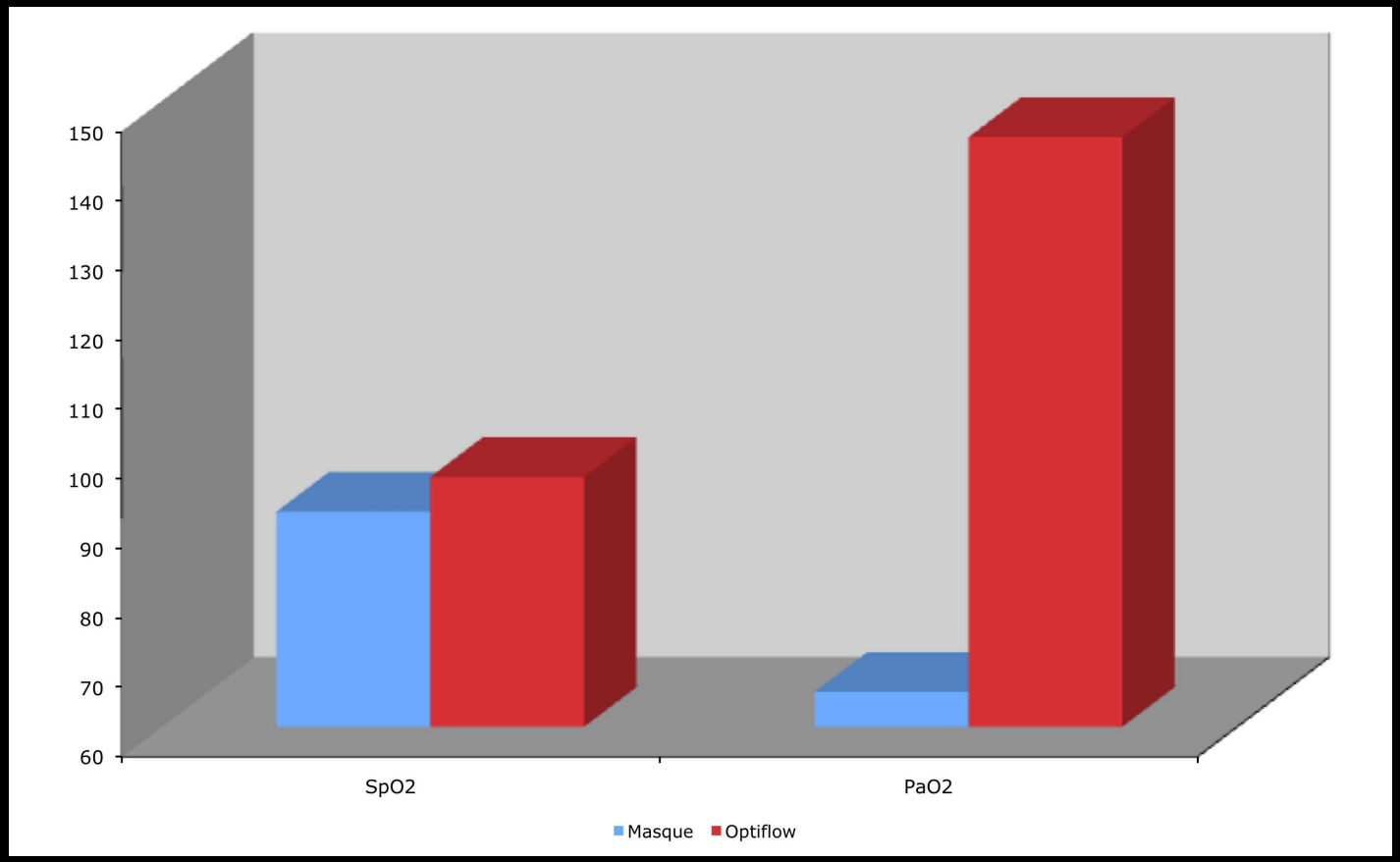
Kercnick J, Austr Crit Care, March, 2010

CCU Patients: a systematic review

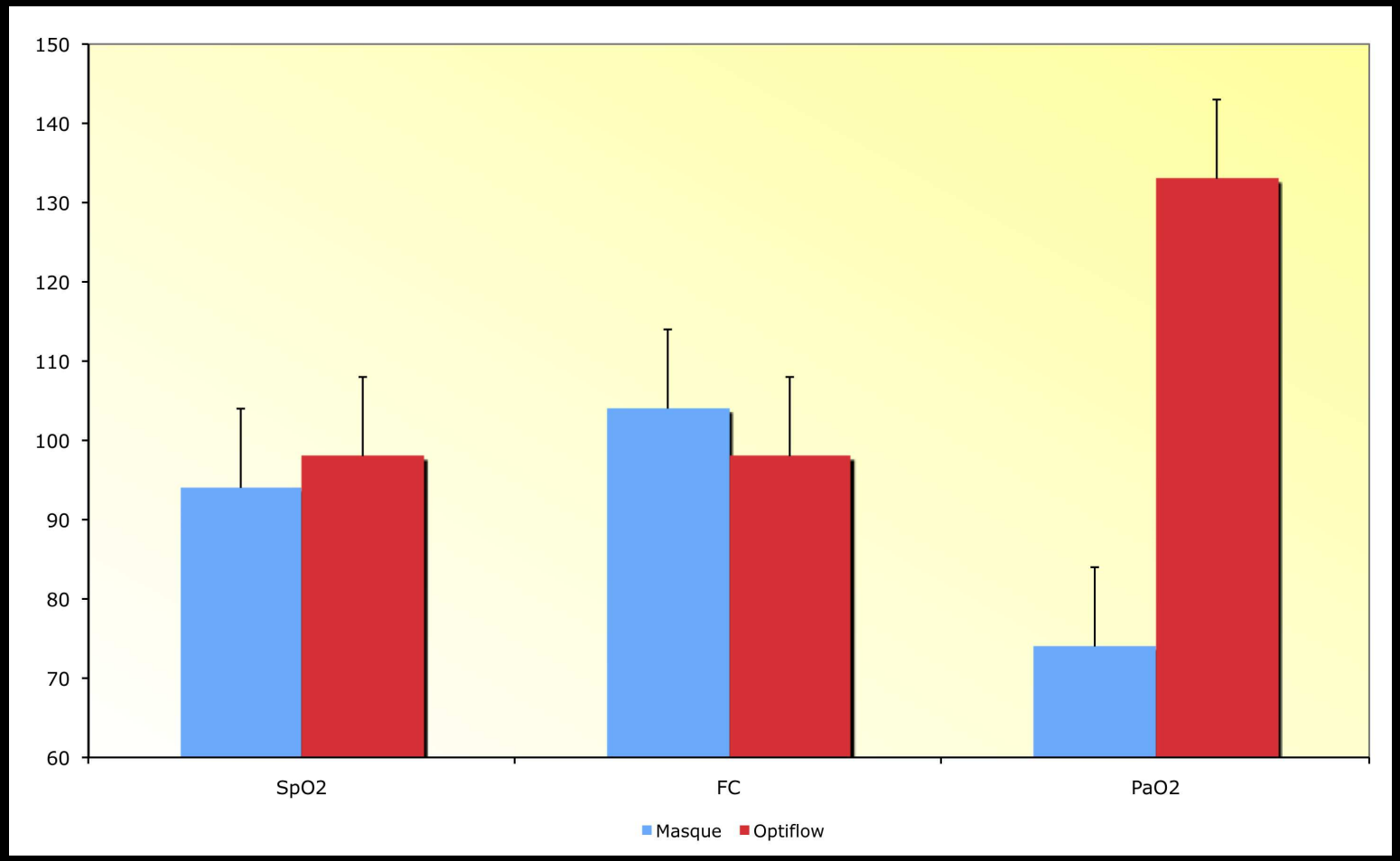
« *Lack of high quality, rigorous research on the topic of HHFNC in the adult critical care patients* »

« *Much of the current research available has been sponsored by the manufacturers of the technologies* »

Kercnick J, Austr Crit Care, March, 2010



Lenglet, SRLF, 2010, tout patient > 6 L O2



Sztrymf, SRLF, 2010, hypoxémie persistante

SNHD et Hypoxémie après Chirurgie Cardiaque
Nicolet, AFAR, 2009, 28 S, R 095

SpO_2 < 96% avec Masque O_2 50%
Optiflow versus Masque Facial Réservoir

Satisfaction	p < 0.001
Sécheresse de Bouche	p < 0.001

SNHD après extubation

Tiruvoipati, J Crit Care, 2009, september

Optiflow versus Oxygen Mask

Idem: arterial blood gases

Better : tolerance, comfort

Femme, 48 ans, pneumopathie infectieuse post PAC
Tabagisme actif

J+4 post-op, IRA hypoxémique
PaO_2 = 50 mm Hg non rebreathing mask 100% O_2

RxThorax: infiltrat bilatéral à prédominance gauche
Bactério: Germe Gram+ (MSSA)
Angioscan: a éliminé une embolie pulmonaire
Echocardo: a montré une bonne fonction

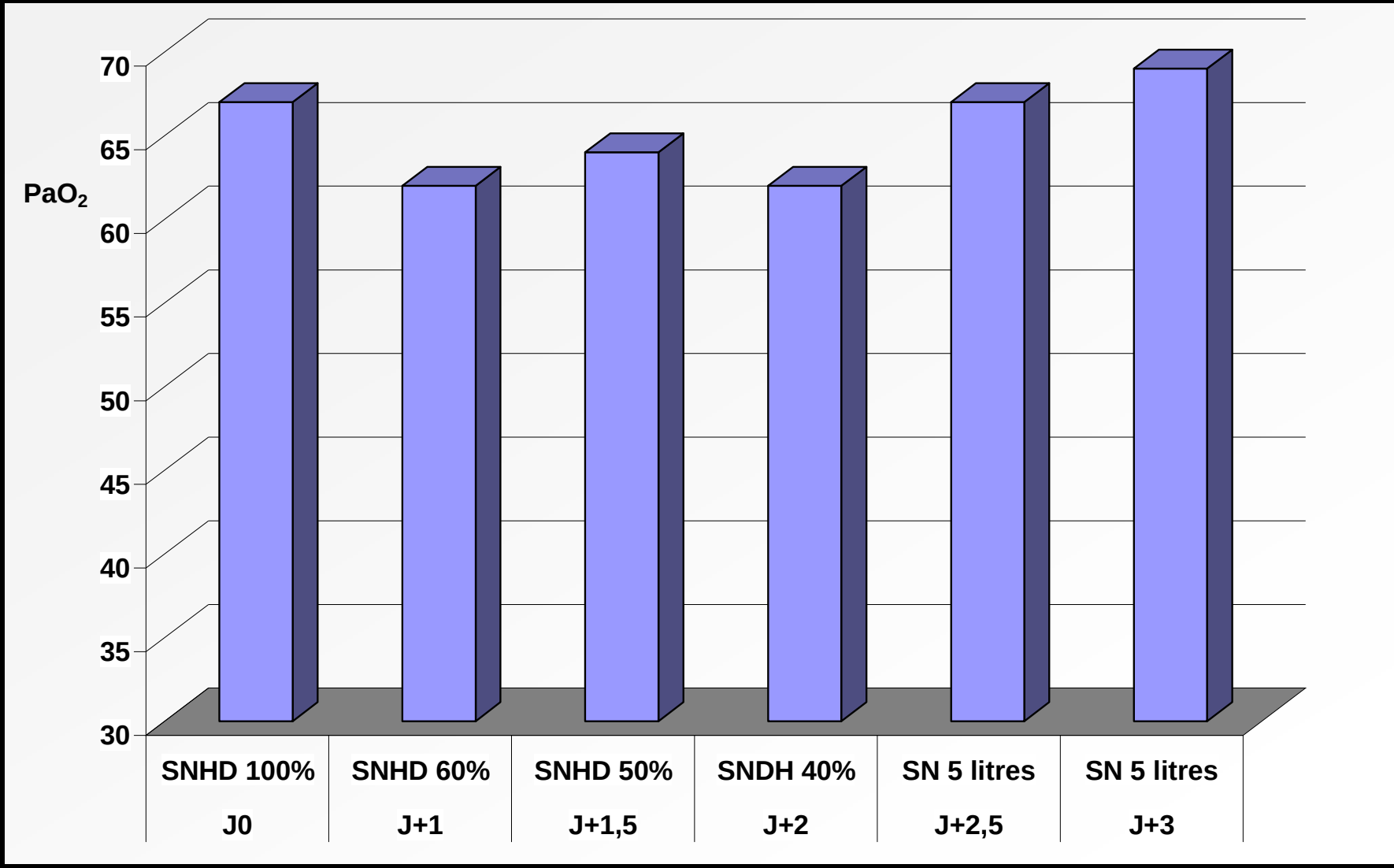
Critères ARDS
- -Evolution aiguë
- -Infiltrat bilatéral
- -PaO_2/FiO_2 < 100 mmHg
- -Œdème non cardiogénique

VS-PEP 10 à 20 O_2 $L.min^{-1}$
entre 15 h^{00} et $17h^{30}$

-FR = 35 min^{-1}
-V_T = 400 mL
-PaO_2 = 60 mm Hg
-Encombrement, toux efficace mais désaturation au retrait du masque
-Consciente mais anxieuse

Passage à la SNHD FiO_2 100%

	H^0	H^{+1}	H^{+3}
	CPAP 20 L	SNHD 100%	SNHD 60%
pH	7,47	7,48	7,5
$PaCO_2$	37	34	31
PaO_2	57	65	62
SaO_2	90	93	93


PaO2
70
65
60
55
50
45
40
35
30
SNHD 100%
J0
SNHD 60%
J+1
SNHD 50%
J+1,5
SNDH 40%
J+2
SN 5 litres
J+2,5
SN 5 litres
J+3

Oxygénothérapie à haut débit

Indication dans l'IRA hypoxémique sur poumon « **de novo** » ?

Cfr recommandations d'experts :

« *Ne pas retarder une intubation devenue indispensable* »

A évaluer en fonction de la clinique

- Répercussions de l'hypoxémie
- Evolution clinique sous CPAP, VNI ou SNHD

Homme, 53 ans, exacerbation aiguë de BPCO
VEMS 19%, Tabagisme actif
Broncho encombrement, bronchospasme, pas de foyer, proteus vulgaris
Somnolence, désaturation au retrait du masque BiPAP

VNI 48 heures: anxieux, ne dort pas, n'aime pas le masque, dyspnéique, signe de Hoover, désaturation rapide (SpO_2) au retrait du masque

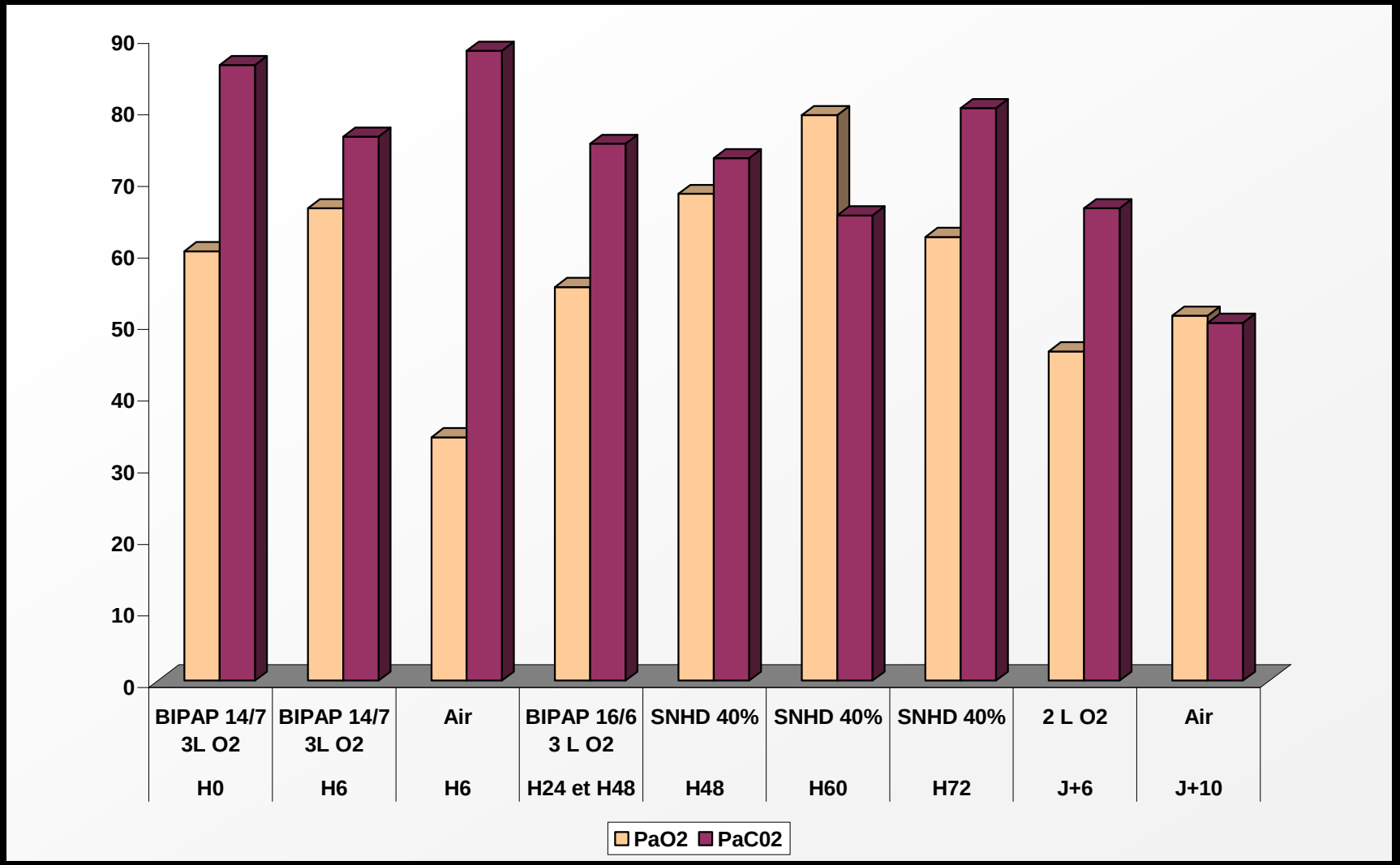
Shift vers Optiflow

vu « *intolérance* »
vu « *oxygénodépendance* » : PaO_2 50-60 mm Hg
vu « *hypercapnie* » : $PaCO_2$ 75-80 mm Hg

Amélioration subjective

nuit correcte, traitement continu, kiné efficace

Transfert en pneumologie avec Optiflow à J+4


90
80
70
60
50
40
30
20
10
0
BIPAP 14/7 3L O2
H0
BIPAP 14/7 3L O2
H6
Air
H6
BIPAP 16/6 3 L O2
H24 et H48
SNHD 40%
H48
SNHD 40%
H60
SNHD 40%
H72
2 L O2
J+6
Air
J+10
PaO2
PaC02

Oxygénothérapie à haut débit

Indication dans l'IRA hypercapnique (EA-BPCO)

Cfr recommandations d'experts :

« *La VNI est le Gold Standard* »

Un haut débit nasal

-Administration continue

-Effet wash-out de CO_2

-Gaz humidifié BTPS (sécrétions)

-FiO_2 titrable


:/ blanco Parenchyme Ax 2f 0.0 Axial

Oxygénothérapie à haut débit

Indication dans la phase tardive d'ARDS

Il n'y a pas de recommandations d'experts !

Deux étapes « délicates »

1. Ventilation contrôlée
2. **Passage en ventilation assistée-contrôlée** **BIPAP**
3. Passage en CPAP sur tube
4. **Extubation et VNI** **SNHD**

Perspectives

-IRA hypoxémiques
patients jeunes avec pneumonie
decubitus ventral en ventilation spontanée
-Pré Oxygénation
-Procédures: intubation, endoscopies diverses
-Post extubation
-Intoxication au CO
-Soins palliatifs
-HTAP

Oxygénothérapie à haut débit

Peut-être plus qu'un effet de mode ?

Simplicité

Tolérance

Données embryonnaires dans la littérature

Efficacité

- FiO_2
- PEEP
- Wash Out

Continuité dans un processus de sevrage

Alternative à une CPAP dans un contexte d'oxygénodépendance ?