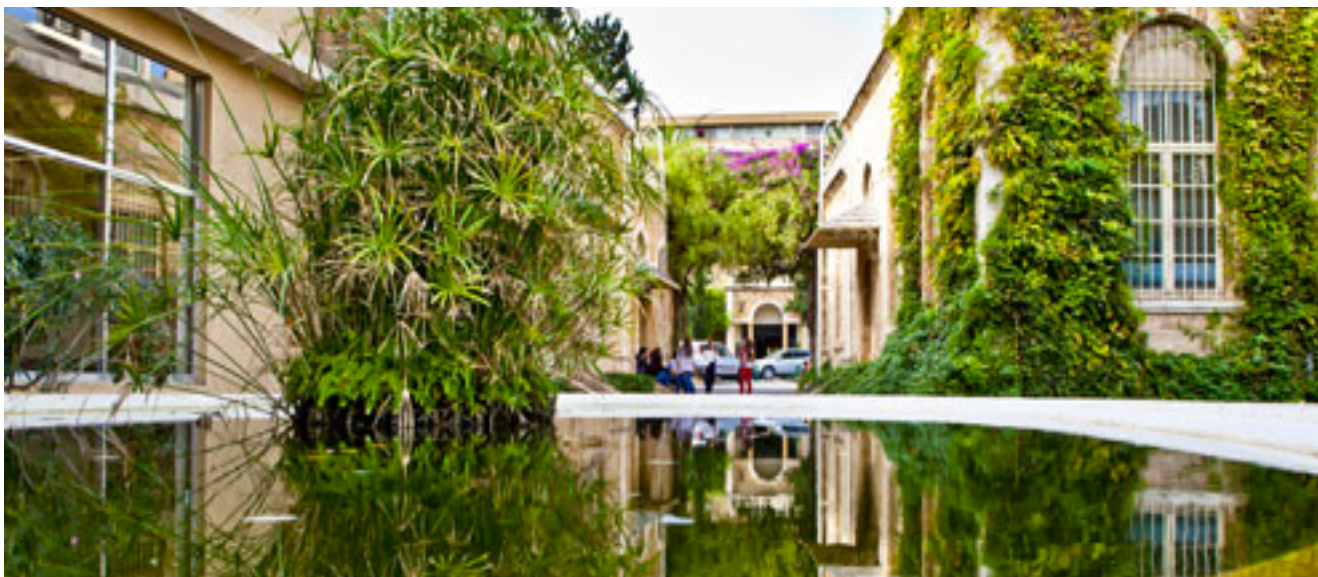




Syndrome d'Obésité-Hypoventilation

Tous les chemins mènent ils à Rome?

AFMP 2019

Ihab IBRAHIM, MD, Msc



Histoire

Sa tête était affaissée sur sa poitrine, seuls un ronflement continu et, de temps à autre, un bruit d'étouffement partiel, révélaient à l'ouïe la présence du grand homme. C'est ainsi que Dickens en 1836 décrit dans "*The pickwick papers*"

En 1956, 1ere publication par Burwell et coll. du syndrome pickwickien

En 1974 on parle de Syndrome d'obésité hypoventilation (Rochester et coll.)



Définition

- Hypoventilation alvéolaire chronique diurne (PaCO₂ >45 mmHg)
- IMC > 30 Kg/m²
- Absence d'affection respiratoire associée pouvant expliquer la gazométrie

SOH ≠ SAHOS

Prévalence

TABLE 1. PREVALENCE OF OBESITY HYPOVENTILATION SYNDROME IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Authors	n	Design	Country	Age (yr)	BMI	AHI	OHS (%)
Verin and colleagues (17)	218	Retrospective	France	55	34	51	10
Laaban and Chailleux (15)	1,141	Retrospective	France	56	34	55	11
Kessler and colleagues (12)	254	Prospective	France	54	33	76	13
Resta and colleagues (16)	219	Prospective	Italy	51	40	42	17
Golpe and colleagues (18)	175	Retrospective	Spain	NA	32	42	14
Akashiba and colleagues (14)	611	Retrospective	Japan	48	29	52	9
Mokhlesi and colleagues. (10)	359	Prospective	USA	48	43	62	20

Physiopathologie du SOH

Augmentation de la résistance des VAS

Mécanique

Compliance diminuée

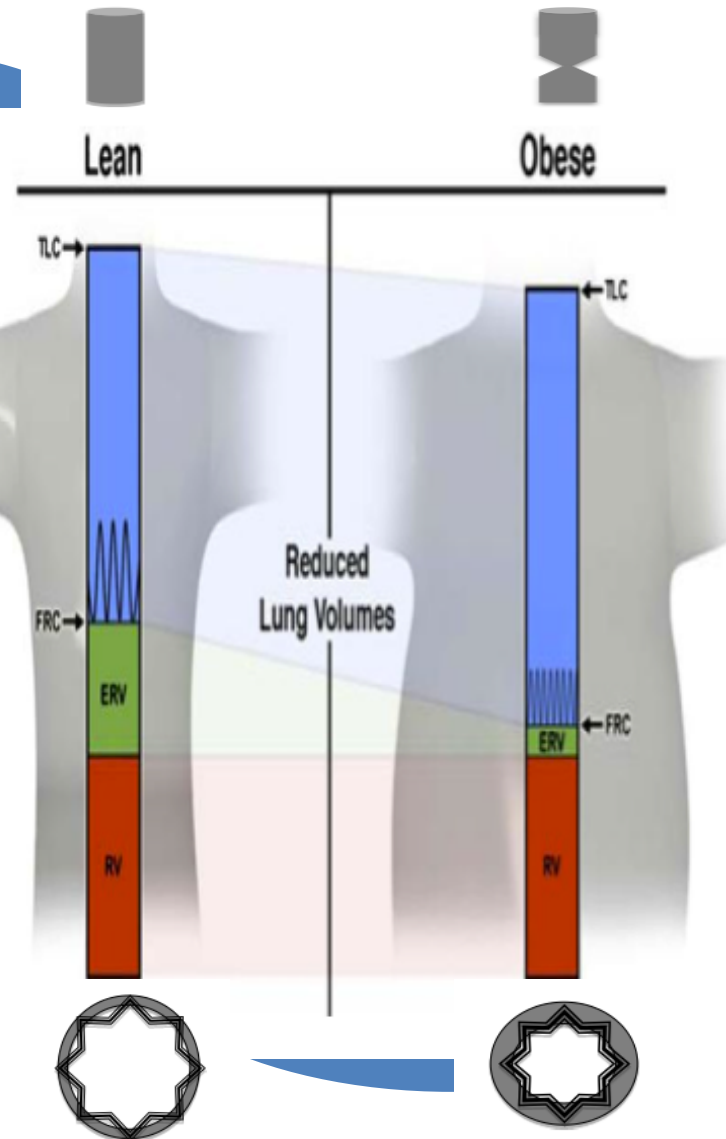
Diminution des Volumes pulmonaires
surtout VRE et la CRF

Dégradation des rapports V/Q au
niveau des bases

Obésité

Commande centrale altérée

Augmentation PEEPi



Physiopathologie du SOH

Leptin Preve

CHRISTOPHER P. O'DONOGHUE
CLARKE G. TANKERSLEY

Am J Respir Crit Care Med

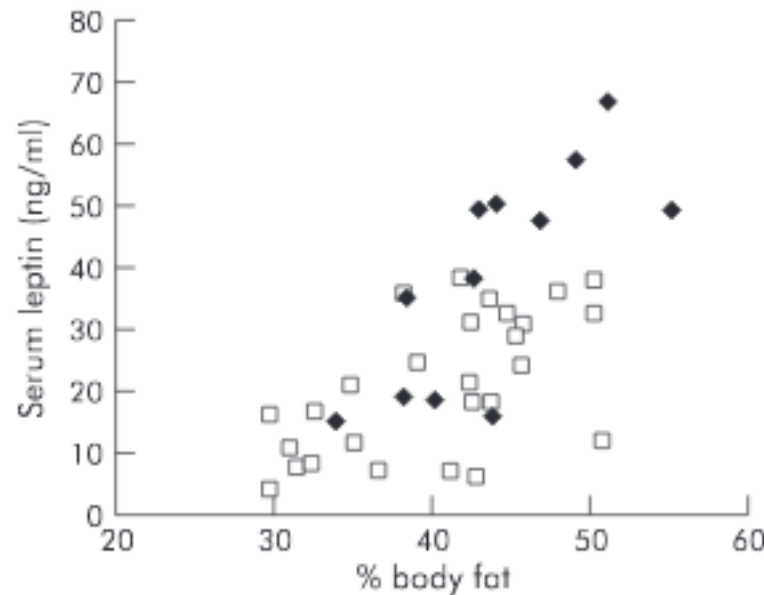
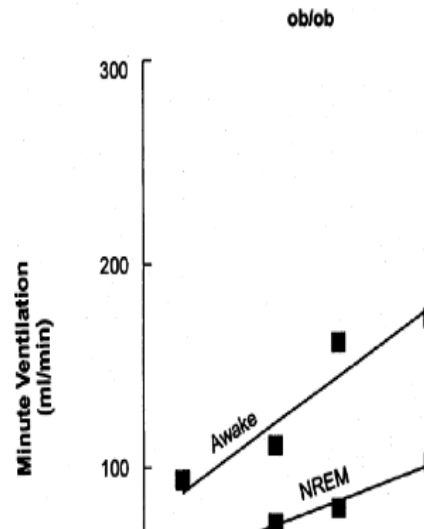
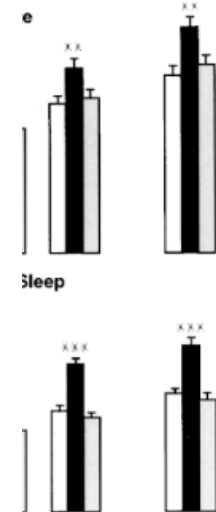


Figure 1 Fasting serum leptin levels versus % body fat in obese hypercapnic (diamonds) and eucapnic (squares) patients. Hypercapnic patients had significantly higher leptin levels ($p < 0.005$).

ity

ITZ,



Association of serum leptin with hypoventilation in human obesity

P R Phipps, E Starritt, I Caterson, R R Grunstein

Thorax 2002;57:75-76

Inspired CO₂ (%)

Physiopathologie du SOH

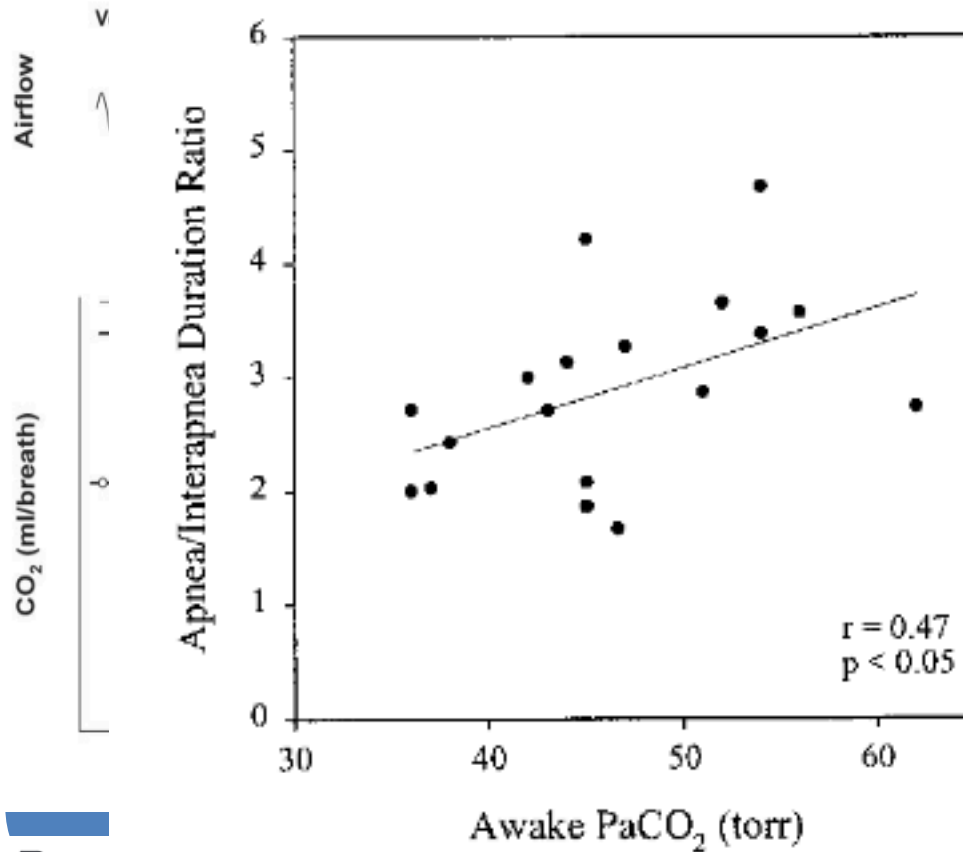


Figure 3. Relationship between chronic awake PaCO_2 and mean apnea/interapnea duration ratio in all subjects. The apnea/interapnea duration ratio measured during sleep was directly related to the chronic PaCO_2 measured during wakefulness.

Post
during respiratory events in obstructive sleep apnea

Ayappa I. Am J Respir Crit Care Med Vol 166. pp 1112–1115, 2002

KENNETH I. BERGER, INDU AYAPPA, I. BARRY SORRIN, ROBERT G. NORMAN,
DAVID M. RAPOPORT, AND ROBERTA M. GOLDRING

Physiopathologie du SOH

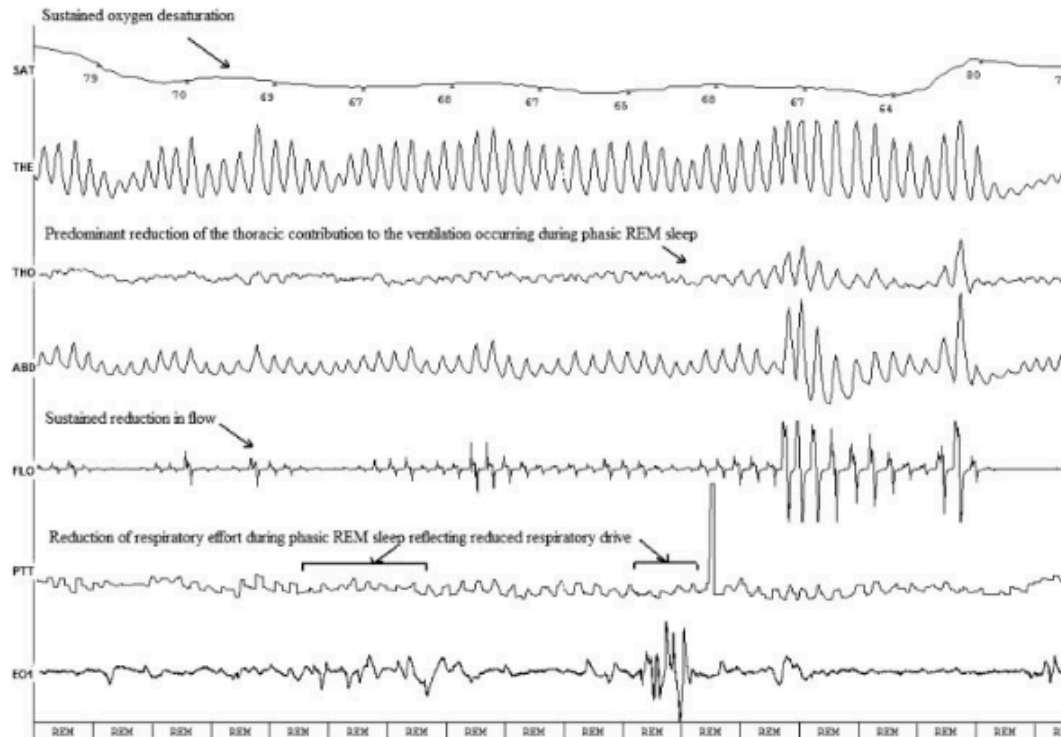


Table 4—Patients With Normal CO₂ Sensitivity Compared to Those With Low CO₂ Sensitivity (n = 15)*

Variables	Low CO ₂ Sensitivity (n = 7)	Normal CO ₂ Sensitivity (n = 8)	p Value
CO ₂ sensitivity, L/min/mm Hg	1.1 ± 0.3	2.8 ± 1.3	0.001
BMI, kg/m ²	38.5 ± 7	38.8 ± 6	NS
PaCO ₂ , mm Hg	47.3 ± 2.3	47.3 ± 2.3	NS
PaO ₂ , mm Hg	78.0 ± 8.3	75.0 ± 6.0	NS
Sleep parameters			
RAI, No. events/h of sleep	54 ± 27	67 ± 20	NS
Non RAI, No. events/h of sleep	6 ± 9	3 ± 2	NS
AHI, No. events/h of sleep	50 ± 38	73 ± 24	0.16
REM HypoVA, %REM sleep	46 ± 37	25 ± 29	0.16
Mean sleep SaO ₂ , %	89 ± 5	89 ± 5	NS
Nadir sleep SaO ₂ , %	63 ± 14	67 ± 15	NS
Time spent with SaO ₂ < 90%, % TST	35 ± 30	39 ± 34	NS
Epworth scale	12 ± 2	11 ± 4	NS
OSLER test	23 ± 14	37 ± 8	0.05
Sleep latency, min			
EP 3–6, n	2.7 ± 5.1	2.7 ± 4.7	NS

*Values are given as the mean ± SD, unless otherwise indicated. See Tables 1–3 for abbreviations not used in the text.

Comman



CHEST

Original Research

NONINVASIVE MECHANICAL VENTILATION

Impaired Objective Daytime Vigilance in Obesity-Hypoventilation Syndrome*

Impact of Noninvasive Ventilation

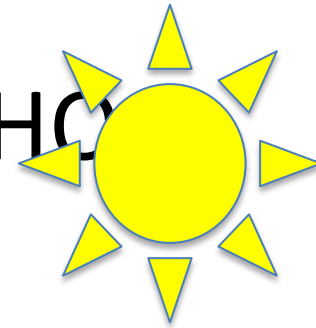
Nathalie Chouri-Pontarollo, MD; Jean-Christian Borel, PT;
Renaud Tamisier, MD, PhD; Bernard Wuyam, MD, PhD;
Patrick Levy, MD, PhD; and Jean-Louis Pépin, MD, PhD

Physiopathologie du SOH



nique

SOH: SAHC

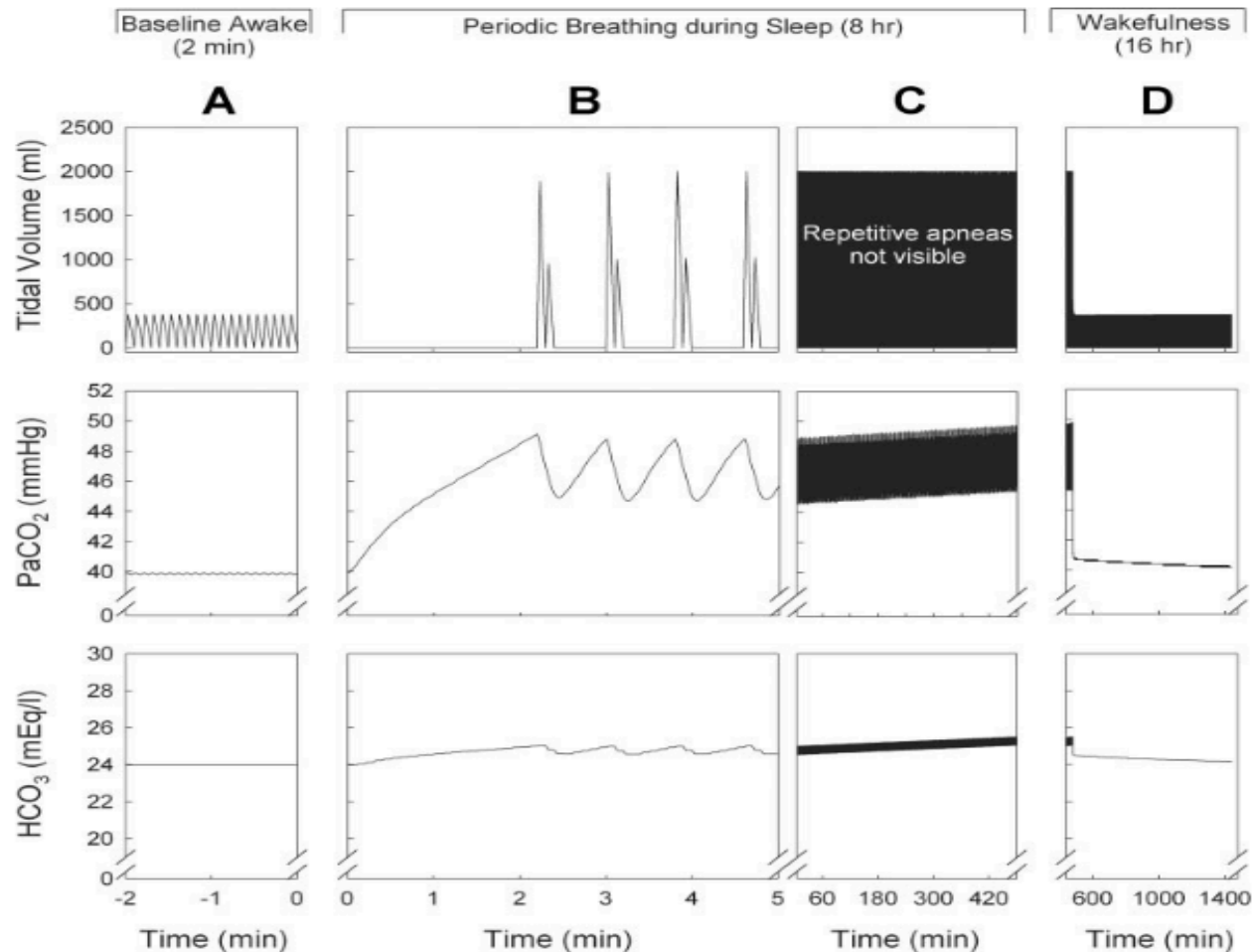


HCO_3^-

Hypoventilation

Évènements obstructifs
Hypoventilation nocturne

Physiopathologie du SOH: HCO_3^-

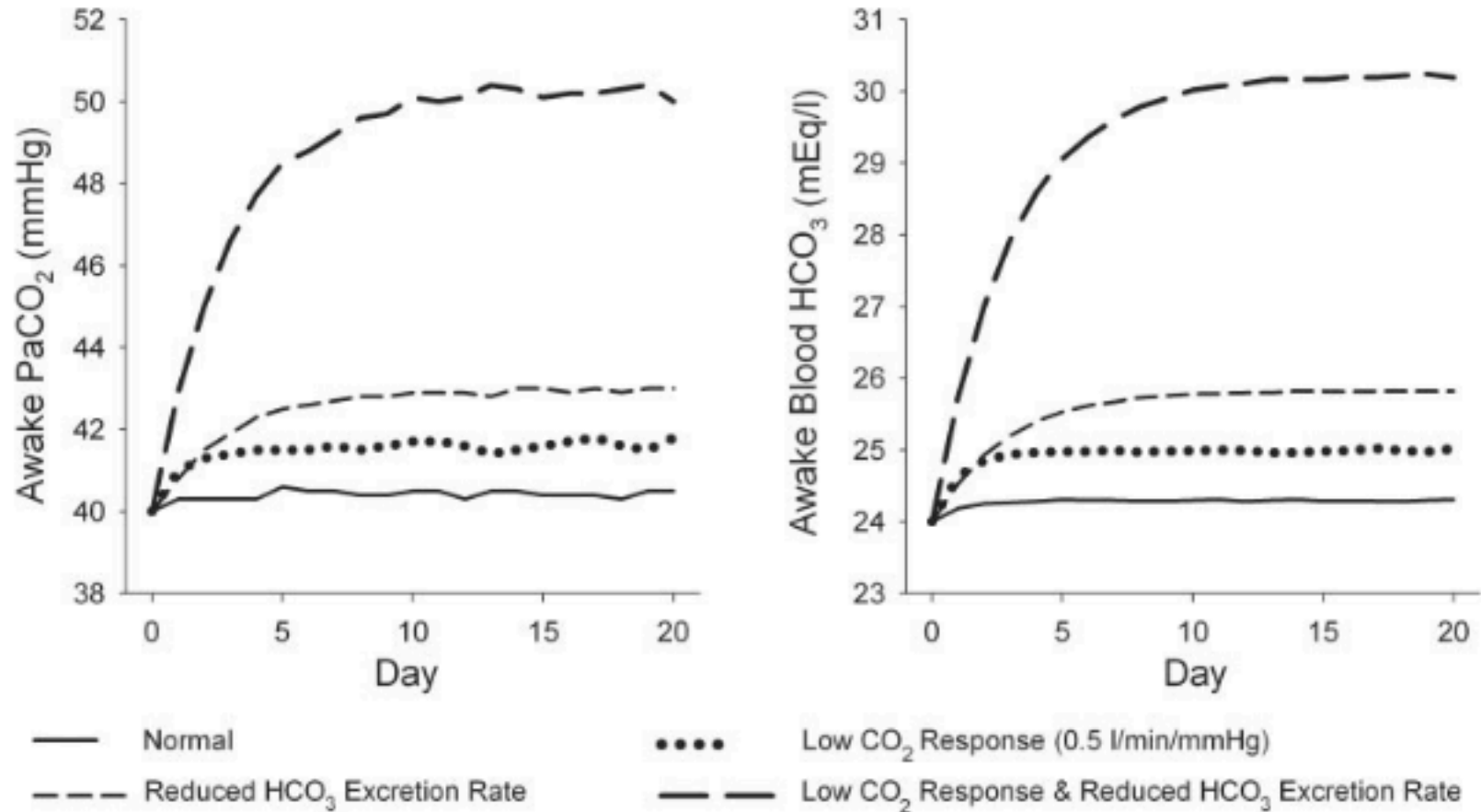


Transition from acute to chronic hypercapnia in patients with periodic breathing: predictions from a computer model

J Appl Physiol 100: 1733–1741, 2006.

Robert G. Norman,¹ Roberta M. Goldring,¹ Jeremy M. Clain,¹ Beno W. Oppenheimer,¹
Alan N. Charney,² David M. Rapoport,¹ and Kenneth I. Berger¹

Physiopathologie du SOH: HCO_3^-

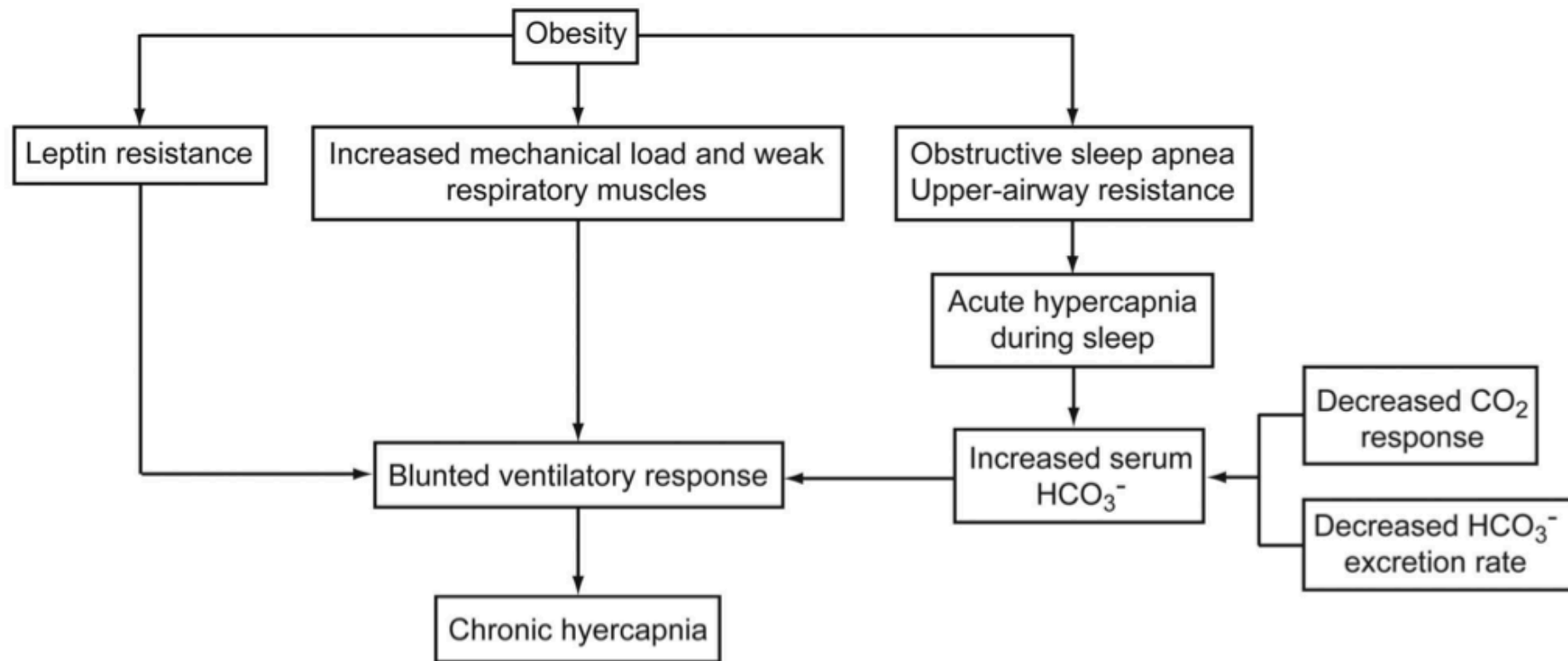


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Physiopathologie du SOH: complexe



Obesity Hypoventilation Syndrome: A State-of-the-Art Review

Babak Mokhlesi MD MSc

RESPIRATORY CARE • OCTOBER 2010 VOL 55 NO 10

SOH: Traitement

- Réduction pondérale:
 - Hygiène de vie
 - Chirurgicale
- Traitement respiratoire:
 - PPC
 - VNI
 - Oxygénothérapie

SOH: PPC

Randomised trial of CPAP vs bilevel support in the treatment of Obesity Hypoventilation Syndrome without severe nocturnal desaturation

	CPAP group	BVS group	p-value
Effective CPAP level (cmH ₂ O)	14 _± 3	13 _± 2	0.65
Min SpO ₂ (%)	70 _± 12	74 _± 10	0.27
%TST<90 (%)	39[16-80]	57[14-86]	0.66
AHI (events/hr)	22 _± 29	13 _± 12	0.22
Sleep efficiency (%)	73 _± 18	80 _± 12	0.18
% REM	23 _± 12	22 _± 12	0.75
Change TcCO ₂ NREM-REM (mmHg)	5 _± 3 [^]	4 _± 2 [#]	0.25

Piper et al.

Thorax Online First, published on January 18, 2008

SOH: PPC

Outcome	Change in CPAP group	Change in BVS group	Mean difference between therapies	[§] p-value
PaCO ₂ (mmHg)	-5.8±8.4*	-6.9±6.7*	1.04 [95% CI: -4.5 to 6.6]	0.7
Awake SpO ₂ (%)	6±3*	8±5*	1.9 [95% CI: -5.2 to 1.3]	0.24
Bicarbonate (mmol/l)	-2.3±8.5*	-2.5±2.5*	0.2 [95% CI: -4.2 to 4.6]	0.93
Weight loss (kgs)	-4.9±7.8*	-5.6±9.4*	0.7 [95% CI: -5.2 to 6.5]	0.82
Mean nightly therapy use (hrs)	5.8±2.4	6.1±2.1	0.33 [95% CI: -1.8 to 1.2]	0.66
ESS	-6±8*	-9±5**	2.89 [95% CI: -1.78 to 7.56]	0.21
PSQI	-1.93±3.5	-5.6±3.9**	3.67 [95% CI: 0.82 to 6.5]	0.013

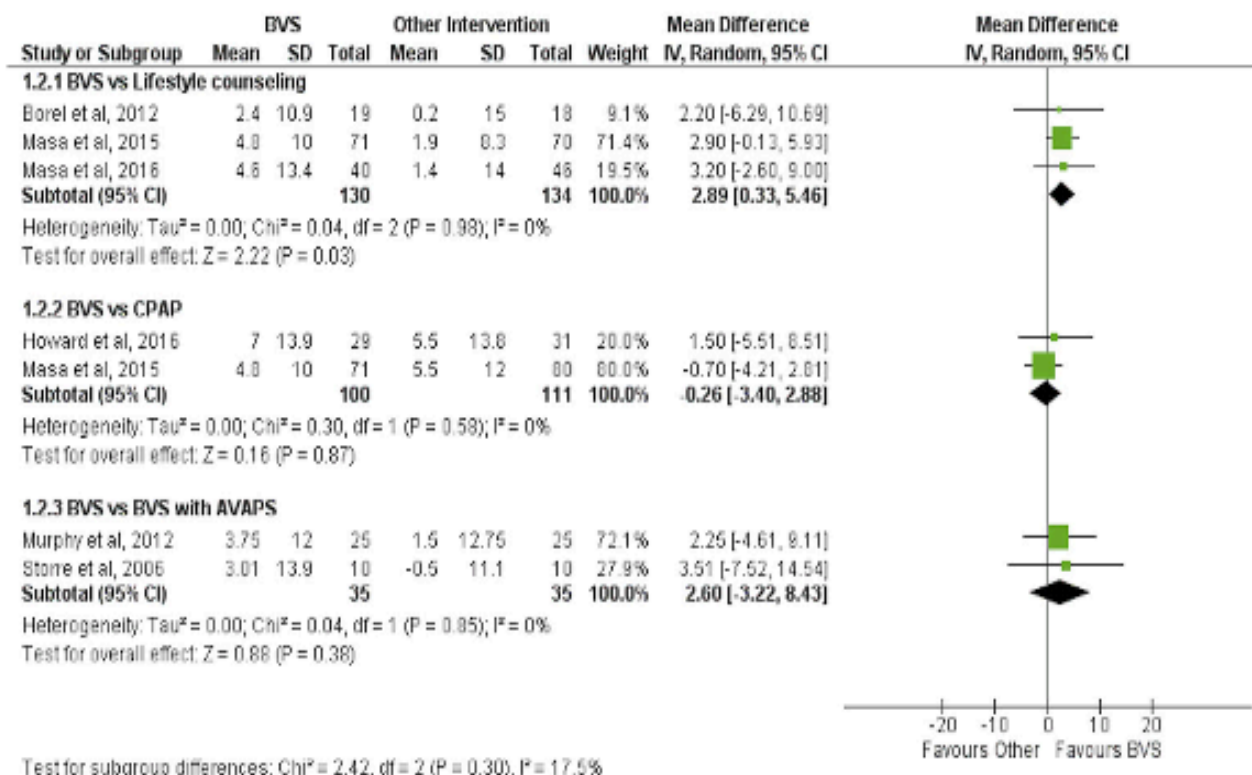
Piper et al.

Thorax Online First, published on January 18, 2008

SOH: PPC

Efficacy of bilevel ventilatory support in the treatment of stable patients with obesity hypoventilation syndrome: systematic review and meta-analysis[☆]

C.P. Royer et al. / Sleep Medicine 53 (2019) 153–164



SOH: PPC

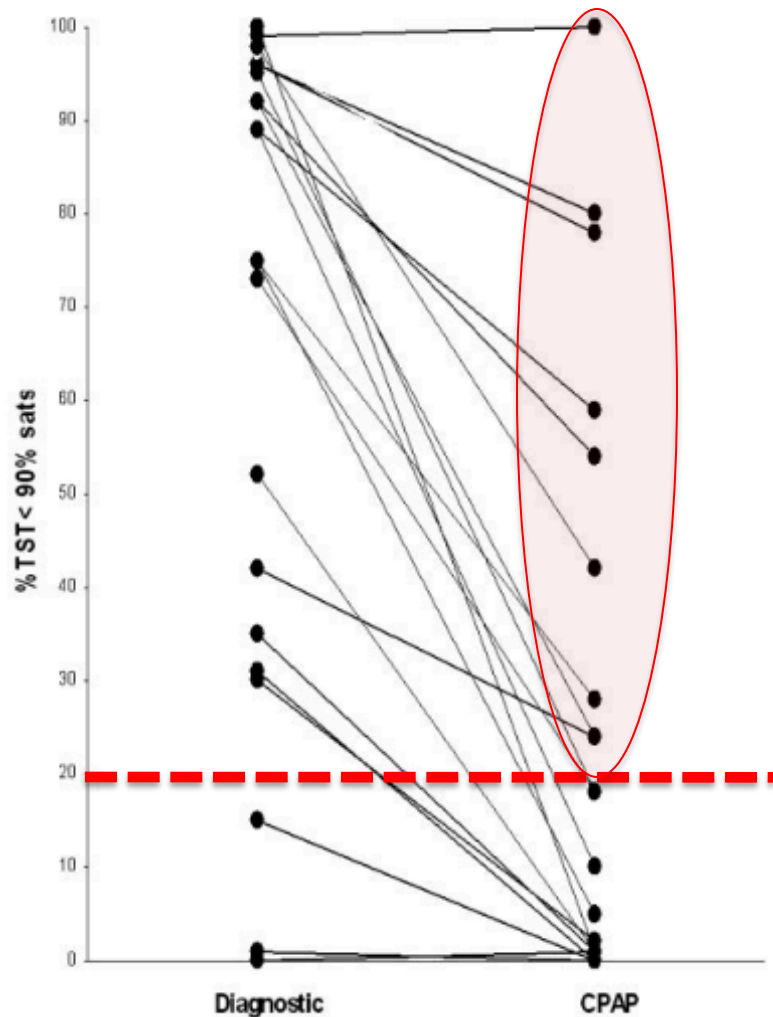
Long-term clinical effectiveness of continuous positive airway pressure therapy versus non-invasive ventilation therapy in patients with obesity hypoventilation syndrome: a multicentre, open-label, randomised controlled trial

	Continuous positive airway pressure (n=107)	Non-invasive ventilation (n=97)	Mean difference (95% CI)	Negative binomial regression		Cox regression model*	
				Adjusted rate ratio (95% CI)	p value	Adjusted hazard ratio (95% CI)	p value
Primary outcome							
Hospitalisation days (per year per patient)	1.63 (3.74)	1.44 (3.07)	-0.19 (-1.13 to 0.75)	0.78 (0.34-1.77)	0.561	..	..
Secondary outcomes							
Health resource utilisation							
Hospital admissions							
At least one	48 (45%)	51 (53%)	..	..	..	1.12 (0.73-1.72)†	0.589
Events per year per patient	0.25 (0.47)	0.24 (0.41)	-0.01 (-0.13 to 0.11)	0.94 (0.58-1.51)	0.783	..	..
Emergency visits							
At least one	66 (62%)	58 (60%)	..	..	..	0.92 (0.62-1.35)†	0.653
Events per year per patient	0.48 (1.04)	0.40 (0.66)	-0.08 (-0.32 to 0.16)	0.87 (0.56-1.35)	0.532	..	..
ICU admissions							
At least one	6 (6%)	4 (4%)	..	..	..	0.81 (0.22-3.06)†	0.754
Events per year per patient	0.03 (0.17)	0.01 (0.04)	-0.02 (-0.06 to 0.01)	0.51 (0.09-2.87)	0.449	..	..
Cardiovascular event	16 (15%)	17 (18%)	..	..	..	1.17 (0.56-2.42)†	0.664
Mortality	16 (15%)	11 (11%)	..	..	..	0.82 (0.36-1.87)	0.631

Data are mean (SD) or n (%), unless otherwise stated. The models were adjusted by sex, age, smoking habits, and forced vital capacity, and included the random effect centre. Difference between treatments was computed as the difference of non-invasive ventilation with respect to continuous positive airway pressure. ICU=intensive care unit. *In the Cox models, no violations of the proportional hazards assumption occurred. †The hazard ratio associated to the time until the first event.

Table 2: Primary and secondary outcomes for continuous positive airway pressure and non-invasive ventilation

SOH: PPC



43% persistance d'une désaturation prolongée malgré un contrôle des évènements obstructifs

Obesity Hypoventilation Syndrome*

Hypoxemia During Continuous Positive Airway Pressure

Banerjee et al.

(*CHEST* 2007; 131:1678–1684)

SOH: PPC

Facteurs prédictifs d'échec de PPC:

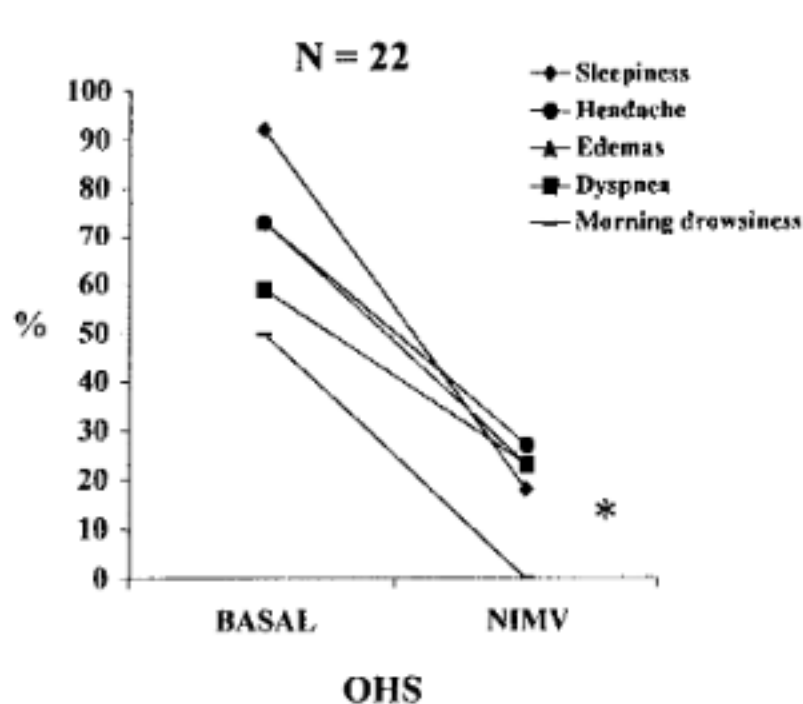
- Hypoventilation avec peu ou pas d'évènements obstructifs +++
- Degré d'obésité
- TVR aux EFR
- TST < 88%
- PaCO₂ diurne +

Banerjee, Chest 2007

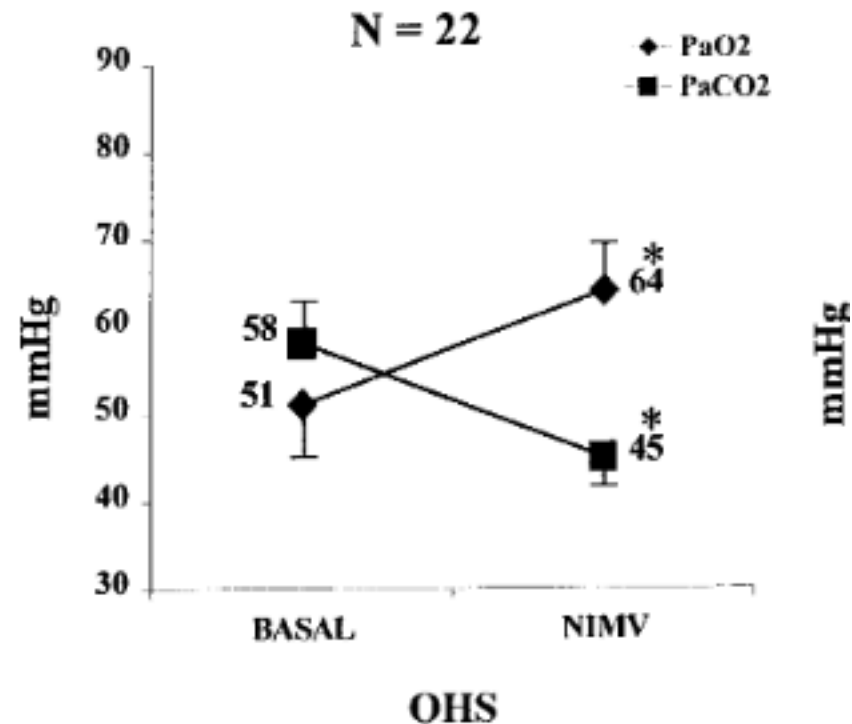
Scahfer, Respir Med 1998

SOH: VNI

The Obesity Hypoventilation Syndrome Can Be Treated With Noninvasive Mechanical Ventilation*



Masa et al.



(CHEST 2001; 119:1102-1107)

SOH: VNI

The Obesity Hypoventilation Syndrome Can Be Treated With Noninvasive Mechanical Ventilation*

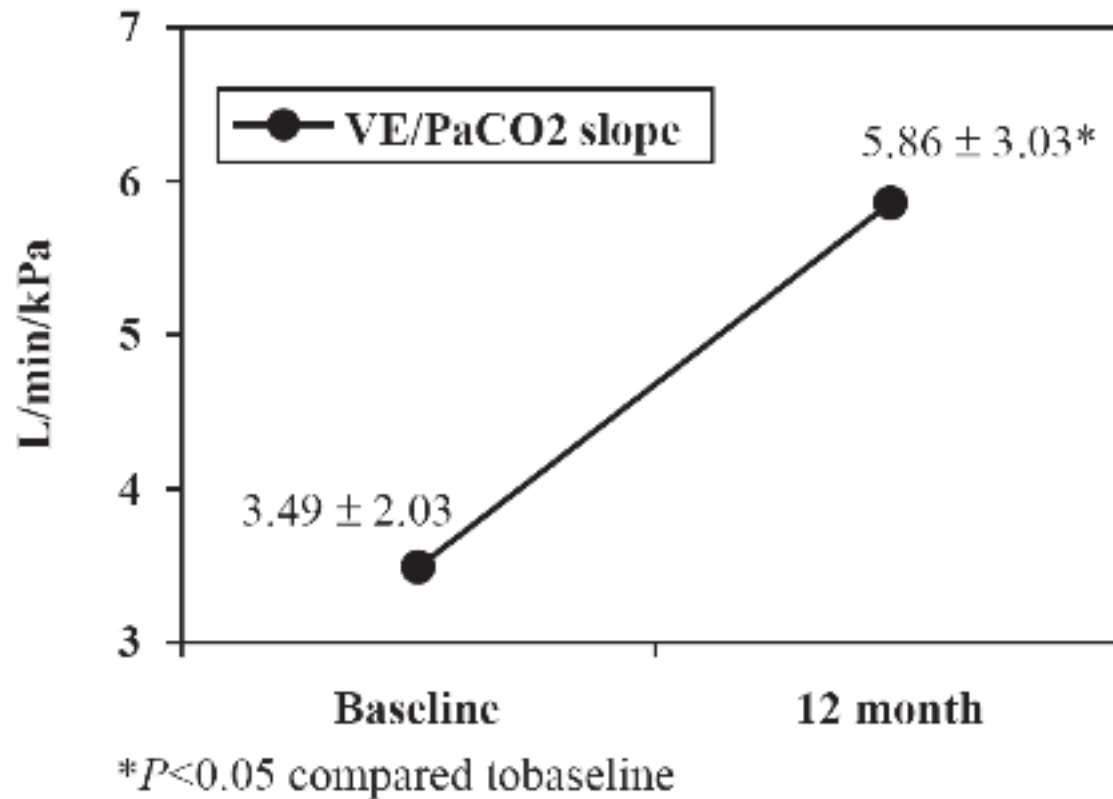
Variables	OHS Group	
	Basal	NIMV
PO ₂	51 ± 10	64 ± 11†
Pco ₂	58 ± 10	45 ± 5†
pH	7.36 ± 0.04	7.41 ± 0.03†
FVC	61 ± 12	62 ± 13
FEV ₁	60 ± 12	61 ± 10
FEV ₁ /FVC	80 ± 13	81 ± 10
TLC	86 ± 13	87 ± 15
RV	126 ± 12	124 ± 13
FRC	100 ± 9	98 ± 10
MIP	55 ± 14	54 ± 12
MEP	56 ± 13	55 ± 12

- Amélioration de la gazométrie
- Pas d'amélioration des paramètres mécaniques

Masa et al.

(*CHEST* 2001; 119:1102–1107)

SOH: VNI

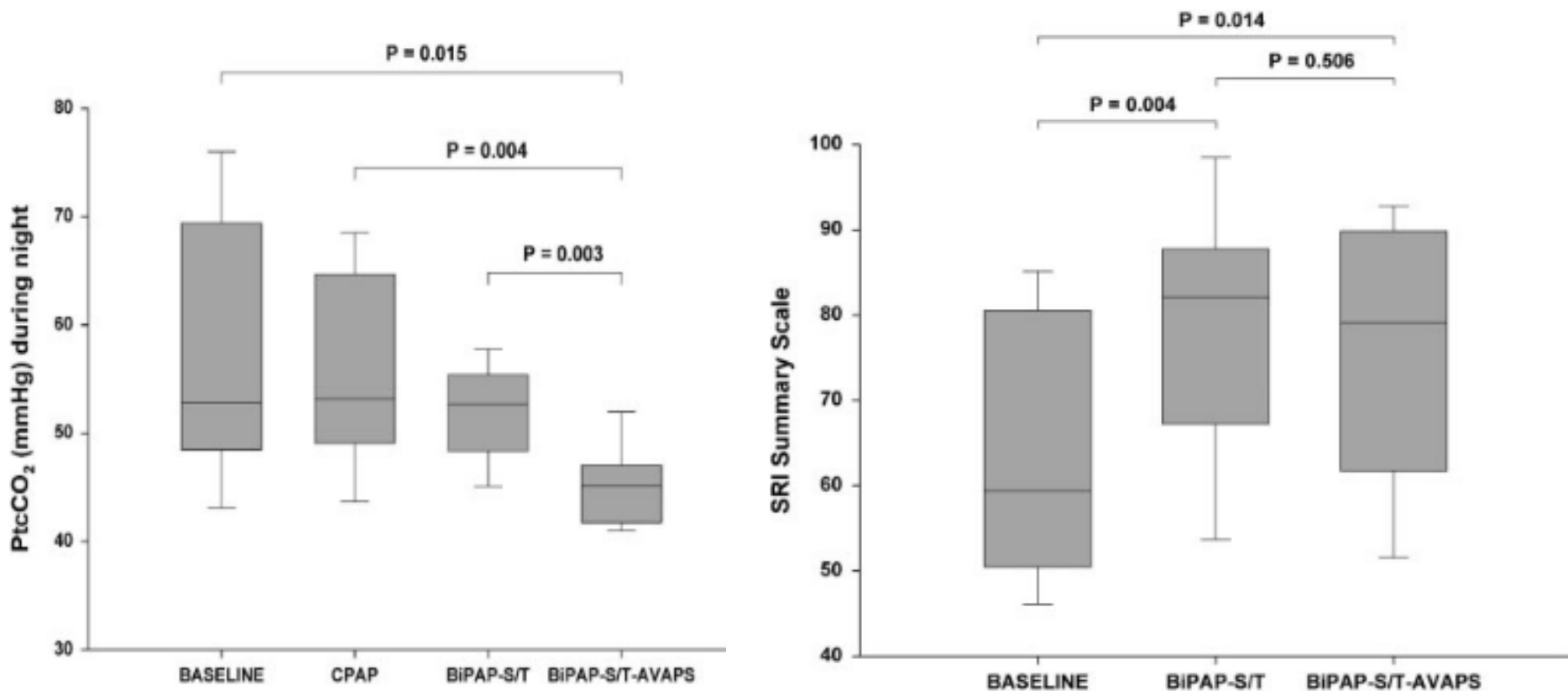


Respir Med. 2004 Oct;98(10):961-7.

Benefits at 1 year of nocturnal intermittent positive pressure ventilation in patients with obesity-hypoventilation syndrome.

de Lucas-Ramos P¹, de Miguel-Díez J, Santacruz-Siminiani A, González-Moro JM, Buendía-García MJ, Izquierdo-Alonso JL.

SOH: BPV-S/T Vs AVAPS



Average Volume-Assured Pressure Support in Obesity Hypoventilation*

Storre et al

A Randomized Crossover Trial

(*CHEST* 2006; 130:815–821)

SOH: BPV-S/T Vs AVAPS

Table 2—Pneumotachygraphic Measurements During Nocturnal BPV-S/T and BPV-S/T-AVAPS Therapy*

Variables	BPV-S/T Therapy	BPV-S/T-AVAPS Therapy
Vinsp, mL	1,133 ± 507	1,094 ± 481
Vexp, mL	312 ± 108	360 ± 115
Vleak, mL	821 ± 595	733 ± 555
PIP, mbar	14.7 ± 2.4	16.4 ± 3.9
PEEP, mbar	6.1 ± 1.1	5.4 ± 1.2
f _b , breaths/min	16.5 ± 3.0	16.8 ± 2.8

Average Volume-Assured Pressure Support in Obesity Hypoventilation*

Storre et al

A Randomized Crossover Trial

(*CHEST* 2006; 130:815–821)

SOH: BPV-S/T Vs AVAPS

Table 3—Polysomnography, Nocturnal PtcCO₂, and Daytime Blood Gas Levels for Patients Receiving CPAP, BPV-S/T, and BPV-S/T-AVAPS Therapy*

Variables	Baseline	CPAP Therapy	BPV-S/T Therapy	BPV-S/T-AVAPS Therapy
TST, min	307 ± 77	309 ± 98	279 ± 124	270 ± 87
Sleep efficiency, %	76 ± 19	80 ± 10	82 ± 27	78 ± 16
NREM sleep stage, % TST				
1	18 ± 11	8 ± 8	9 ± 11	14 ± 14
2	66 ± 20	57 ± 17	54 ± 13	53 ± 24
3 + 4	10 ± 11	19 ± 11	28 ± 9†	22 ± 14†
REM sleep, % TST	6 ± 6	16 ± 10	10 ± 10	11 ± 14
Arousals, No./h)	53 ± 26	22 ± 21†	25 ± 27†	27 ± 18†
RDI score, events/h	74 ± 25	25 ± 21†	21 ± 15†	31 ± 21†
Apnea index, events/h	21 ± 17	2 ± 3†	0 ± 0†	0 ± 0†
SaO ₂ , %	88 ± 5	92 ± 2†	92 ± 2†	92 ± 1†
Desaturation index, events/h	78 ± 26	29 ± 18†	27 ± 15†	33 ± 17†
PtcCO ₂ , mm Hg	58 ± 12	56 ± 9	52 ± 4	45 ± 3†
Heart rate, beats/min	69 ± 14	67 ± 13	67 ± 14	65 ± 11
PH	7.39 ± 0.02	7.39 ± 0.03	7.40 ± 0.04	7.42 ± 0.04
PaCO ₂ , mm Hg	47.4 ± 2.0	48.0 ± 5.0	45.9 ± 3.7	42.0 ± 5.2†
PaO ₂ , mm Hg	73.3 ± 6.3	70.0 ± 7.4	76.31 ± 12.4	72.8 ± 9.1
HCO ₃ ⁻ , mmol/L	28.0 ± 1.0	28.4 ± 1.8	27.8 ± 1.8	26.5 ± 2.0†

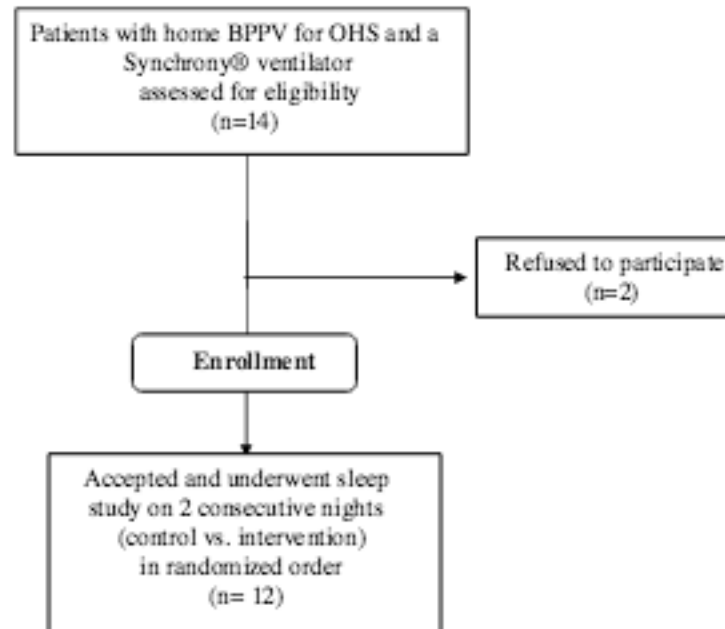
Average Volume-Assured Pressure Support in Obesity Hypoventilation*

Storre et al

A Randomized Crossover Trial

(CHEST 2006; 130:815–821)

SOH: BPV-S/T Vs AVAPS



Impact of volume targeting on efficacy of bi-level non-invasive ventilation and sleep in obesity-hypoventilation^{☆,☆☆}

SOH: BPV-S/T Vs AVAPS

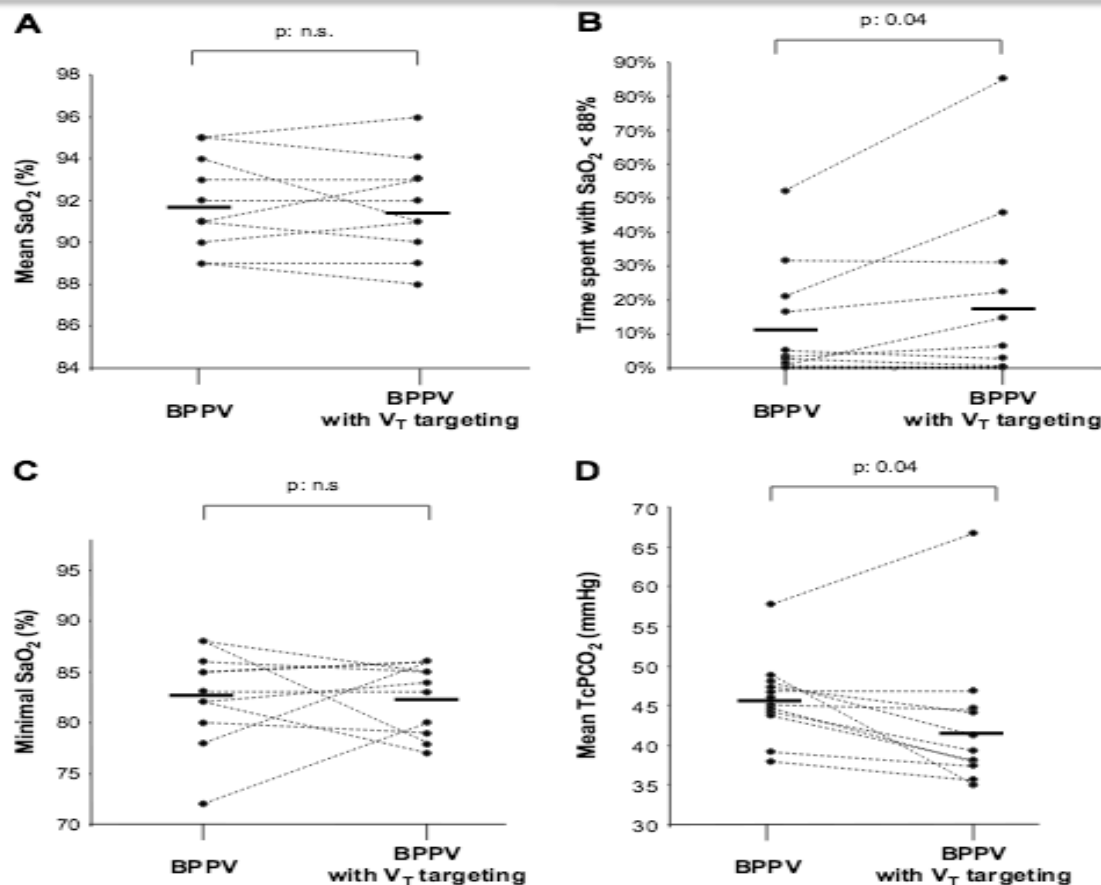
Table 1 Ventilators settings with and without V_T targeting and estimated V_T .

Baseline ventilator settings				Ventilator settings with V_T targeting					
Patient number	IPAP (cm H ₂ O)	EPAP (cm H ₂ O)	Respiratory back-up (rate/min)	IPAP min (cm H ₂ O)	IPAP max (cm H ₂ O)	Targeted V_T (ml)	Targeted V_T (ml/kg)	Estimated V_T (ml)	Estimated V_T (ml/kg)
1	22	6	15	19	30	900	7.8	714	6.2
2	18	6	12	15	25	500	8.5	464	7.9
3	28	5	17	24	30	825	7.5	678	6.2
4	24	8	12	21	30	1000	7.1	790	5.6
5	19	14	12	18	24	1000	7.1	744	5.3
6	14	8	14	15	21	1000	7.4	693	5.1
7	26	12	12	23	30	900	8.2	898	8.2
8	28	8	10	25	30	975	8.1	808	6.7
9	26	12	14	23	29	1000	5.7	969	5.5
10	18	8	15	15	25	850	7.0	774	6.3
11	18	8	15	8	25	1200	8.1	964	6.5
12	18	8	12	15	25	800	7.9	680	6.7
Mean	21.6	8.6	13.3	18.4	27.0	912.5	7.5	765	6.4
SD	4.7	2.7	2.0	5.0	3.2	168.4	0.8	140	0.9

V_T : tidal volume, ml; IPAP: inspiratory positive airway pressure, cm H₂O; EPAP: expiratory positive airway pressure, cmH₂O; EPAP and back-up respiratory rate settings were not modified. Subjects 3, 7 and 8 had supplemental O₂.

Impact of volume targeting on efficacy of bi-level non-invasive ventilation and sleep in obesity-hypoventilation^{☆,☆☆}

SOH: BPV-S/T Vs AVAPS



Impact of volume targeting on efficacy of bi-level non-invasive ventilation and sleep in obesity-hypoventilation☆☆☆

SOH: BPV-S/T Vs AVAPS

Table 2 Polysomnographic data with and without V_T targeting.

	Without V_T targeting mean $\pm$ SD	With V_T targeting mean $\pm$ SD	p Value
TST (min)	397 $\pm$ 79	334 $\pm$ 68	0.004
Sleep efficiency (%)	75 $\pm$ 10	68 $\pm$ 11	0.06
Sleep latency (min)	14 $\pm$ 12	21 $\pm$ 19	0.1
Stage 1 (% of TST)	22.6 $\pm$ 6.4	25.7 $\pm$ 8.7	0.07
Stage 2 (% of TST)	55.6 $\pm$ 6.9	50.4 $\pm$ 6.3	0.007
Slow wave sleep (% of TST)	8.8 $\pm$ 5.3	10.6 $\pm$ 5.6	0.11
REM sleep (% of TST)	13.8 $\pm$ 5.4	13.2 $\pm$ 5.8	0.28
Stage changes (n)	394 $\pm$ 145	326 $\pm$ 98	0.019
Wake after sleep onset (% of TST)	25.8 $\pm$ 10.6	33.8 $\pm$ 12.0	0.017
Awakenings >2 min (n)	101 $\pm$ 38	97 $\pm$ 29	0.31
Awakenings >20 s (n)	11 $\pm$ 7	16 $\pm$ 8	0.05
Micro-arousal index (n/h)	32 $\pm$ 11	30 $\pm$ 12	0.22
Sleep fragmentation index (n/h)	75 $\pm$ 27	78 $\pm$ 30	0.27

TST: total sleep time; REM: rapid eye movement sleep; p value for paired Student's t test.

Table 3 Patient's rating of quality of sleep and comfort of ventilation with and without V_T targeting, assessed by St. Mary's Hospital Questionnaire and eight visual analogic scales.

St. Mary's Hospital sleep questionnaire	Without V_T targeting mean $\pm$ SD	With V_T targeting mean $\pm$ SD	p Value
Depth of sleep (scale range: 1–8) ^a	5.6 $\pm$ 1.6	3.3 $\pm$ 1.7	0.005
Number of awakenings	3.3 $\pm$ 2.0	4.9 $\pm$ 2.3	0.01
Duration of sleep (hh:mm)	07:13 $\pm$ 02:16	05:33 $\pm$ 02:31	0.06
Quality of sleep (scale range: 1–5) ^a	3.8 $\pm$ 0.6	2.8 $\pm$ 1.2	0.05
Morning sleepiness (scale range: 1–6) ^a	4.0 $\pm$ 0.7	3.6 $\pm$ 1.0	0.13
Satisfaction with quality of sleep (scale range: 1–5) ^a	3.8 $\pm$ 1.1	2.9 $\pm$ 1.1	0.08
Early awakening (yes/no)	6/6	6/6	
Difficulty in falling asleep (scale range: 1–4)	1.4 $\pm$ 1.0	2.1 $\pm$ 1.3	0.04
Time needed to fall asleep (hh:mm)	00:46 $\pm$ 01:10	00:54 $\pm$ 00:55	0.2
Comfort of ventilation (VAS scales, 0–10)			
Comfort of ventilation ^a	7.5 $\pm$ 1.9	6.0 $\pm$ 2.5	0.018
Desynchronisation perceived by patient ^a	7.5 $\pm$ 2.2	6.1 $\pm$ 3.1	0.2
Too much air delivered ^a	9.0 $\pm$ 1.9	6.0 $\pm$ 3.8	0.012
Too little air delivered ^a	7.7 $\pm$ 2.9	8.0 $\pm$ 2.8	1.00
Morning headache ^a	9.7 $\pm$ 0.9	9.7 $\pm$ 0.7	1.00
Perception of leaks ^a	7.7 $\pm$ 2.4	4.8 $\pm$ 3.7	0.016
Noise of ventilator ^a	7.5 $\pm$ 2.2	6.5 $\pm$ 2.8	0.44
Quality of sleep ^a	6.8 $\pm$ 2.6	4.8 $\pm$ 2.7	0.02

Impact of volume targeting on efficacy of bi-level non-invasive ventilation and sleep in obesity-hypoventilation☆☆☆

SOH: Traitement

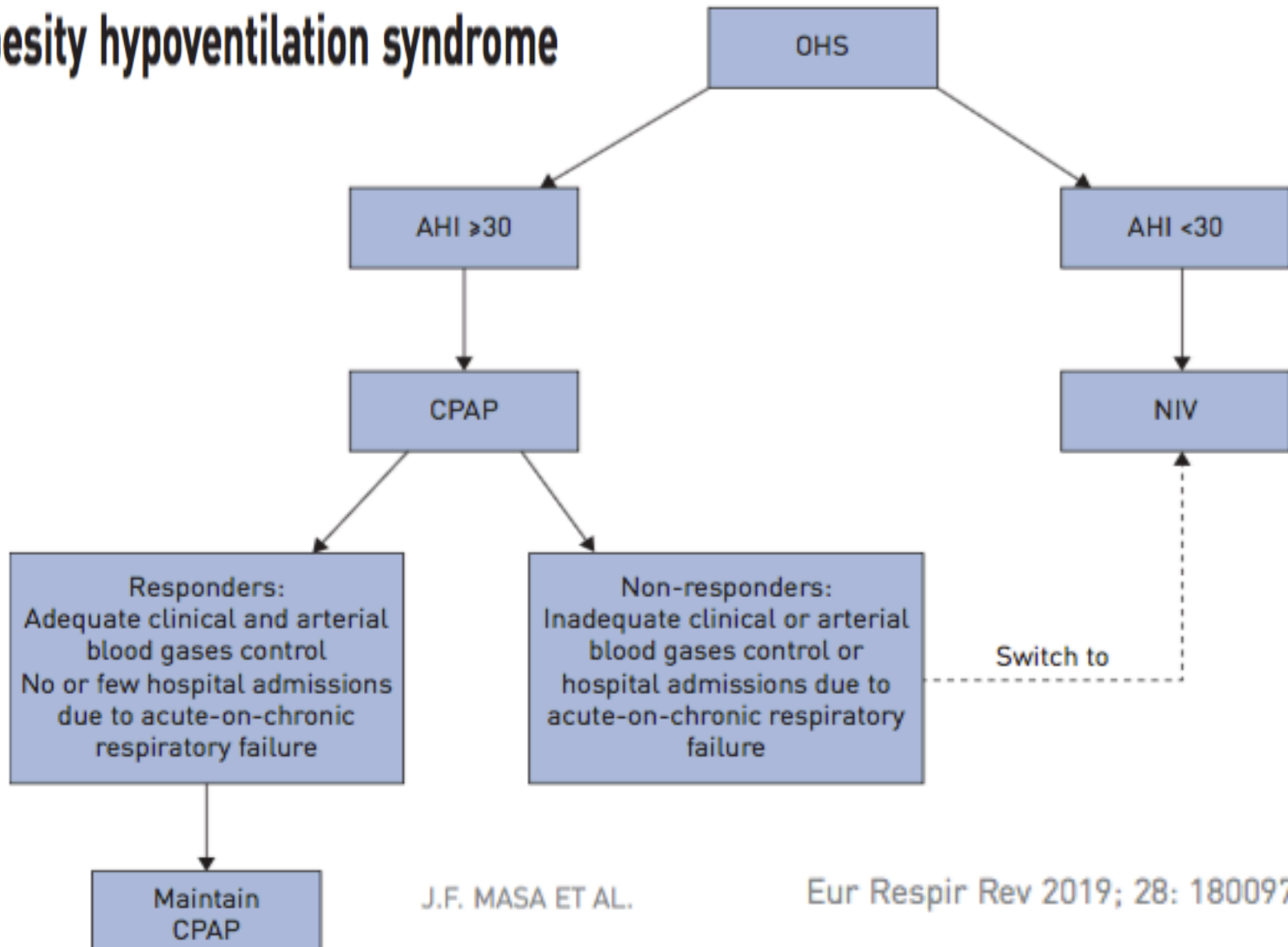


BiPAP

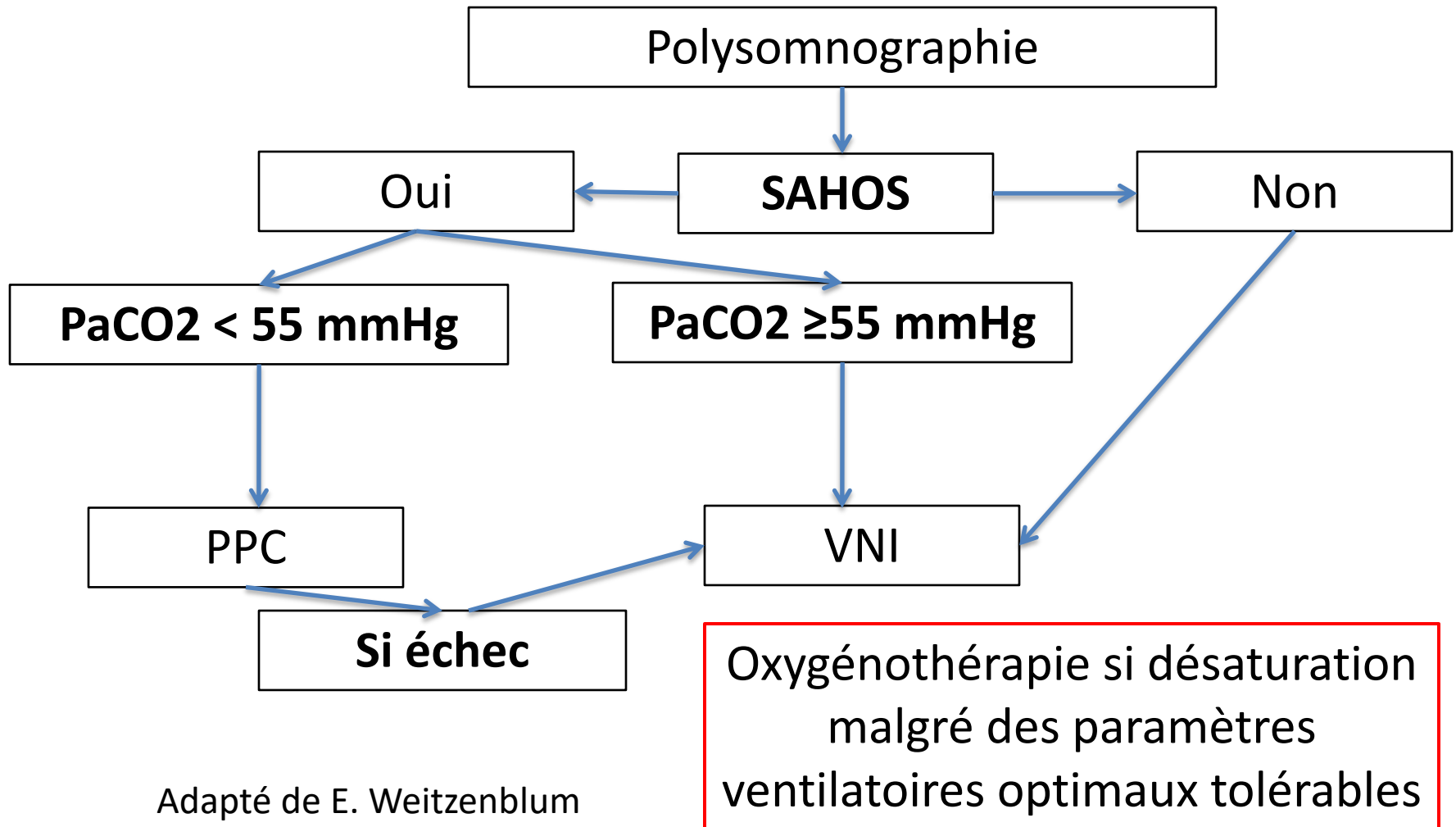


SOH: Traitement

Obesity hypoventilation syndrome



SOH: Traitement



Adapté de E. Weitzenblum

Rev Mal Respir 2006 ; 23 : 7S65-7S67



All roads lead to rome.

Obesity Hypoventilation Syndrome

Choosing the Appropriate Treatment of a Heterogeneous Disorder

Sleep Med Clin 12 (2017) 587–596

Table 1

Overview of positive airway pressure therapies for obesity hypoventilation syndrome

PAP Mode	Uses and Benefits	Comments
CPAP	• Suitable as initial therapy trial in patients with stable OHS with moderate to severe OSA • Can be considered in some patients after initial stabilization with BPAP • Least costly of all PAP therapy	• Pressures 10–16 cm H₂O generally required • Improvement in awake gas exchange over the first month may be slower compared with BPAP modes • Lack of long-term comparative data with other modes of PAP
BPAP-spontaneous	• Suitable for patients with good drive and ability to trigger consistently to IPAP in all sleep stages • Less expensive than spontaneous-timed modes of PAP	• Limited comparative data with other PAP modes • May induce central events if not titrated correctly
BPAP–spontaneous-timed	• Widely used in acute and home settings • First-line therapy for patients with isolated nocturnal hypoventilation • Can be set to provide a minimum rate or to achieve passive ventilation	• Patient-ventilator asynchrony can persist and impact on efficacy • Also recommended when respiratory rate remains low or minute ventilation is reduced despite best pressure support
BPAP with volume-targeted pressure support	• Should provide more stable ventilation by targeting a predetermined tidal volume • Adapts to changes in sleep stage, posture, and lung mechanics on a continuous basis	• Variable air leaks and persisting airway obstruction may reduce efficacy • Should reduce the need for manual titration of pressures • No evidence of additional clinical benefits compared with other PAP modes