Quels interactions entre le patient et le ventilateur dans la ventilation au long cours?

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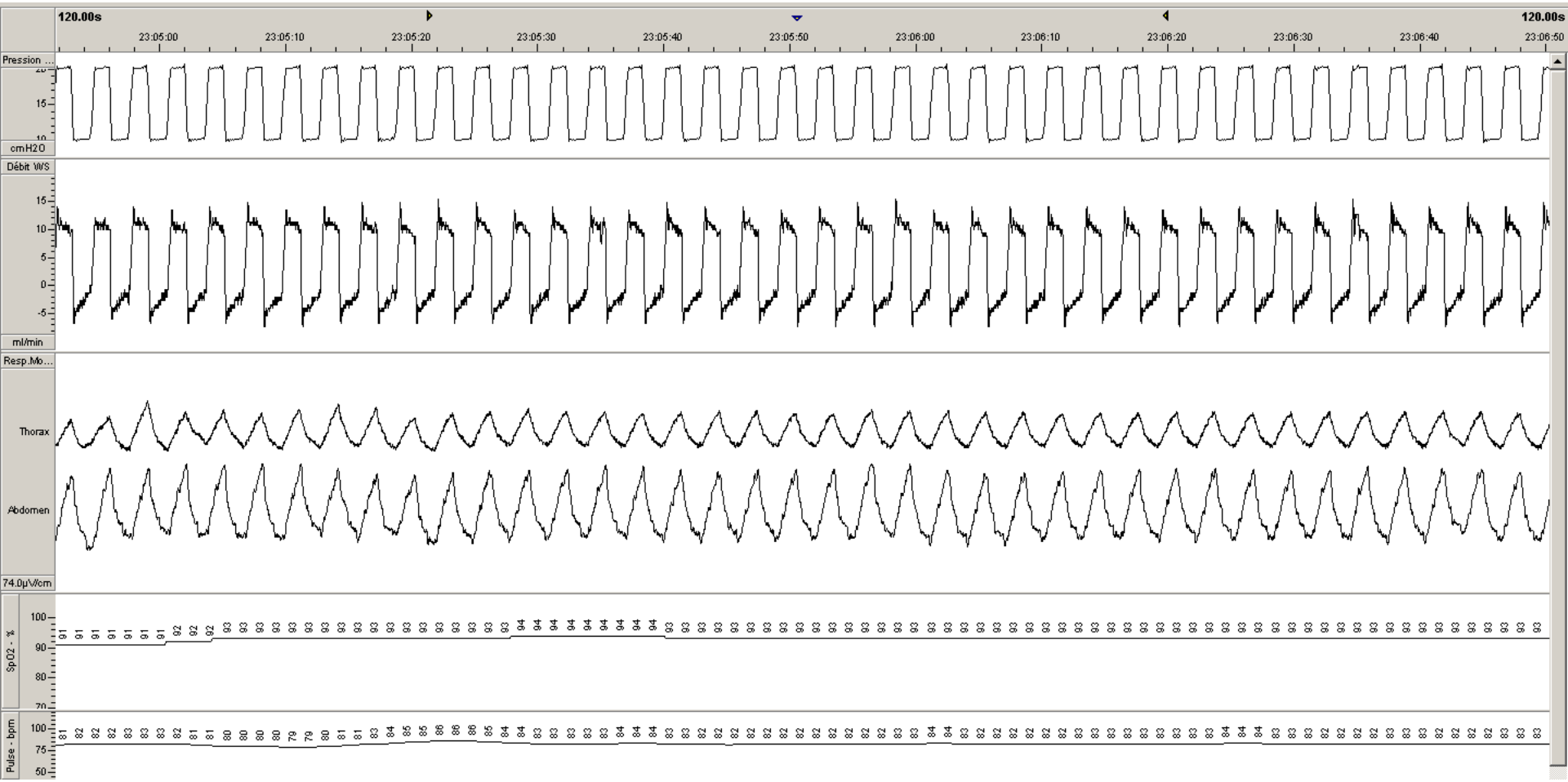
But de la VNI

- Améliorer les gaz du sang diurnes
- Améliorer la SpO_2 nocturne et corriger l'hypoventilation alvéolaire nocturne
- Améliorer les symptômes liés à l'hypercapnie et la dyspnée
- Améliorer la qualité du sommeil

Ventilation synchronisée

Ventilation idéale au cours du sommeil



Ventilation synchronisée

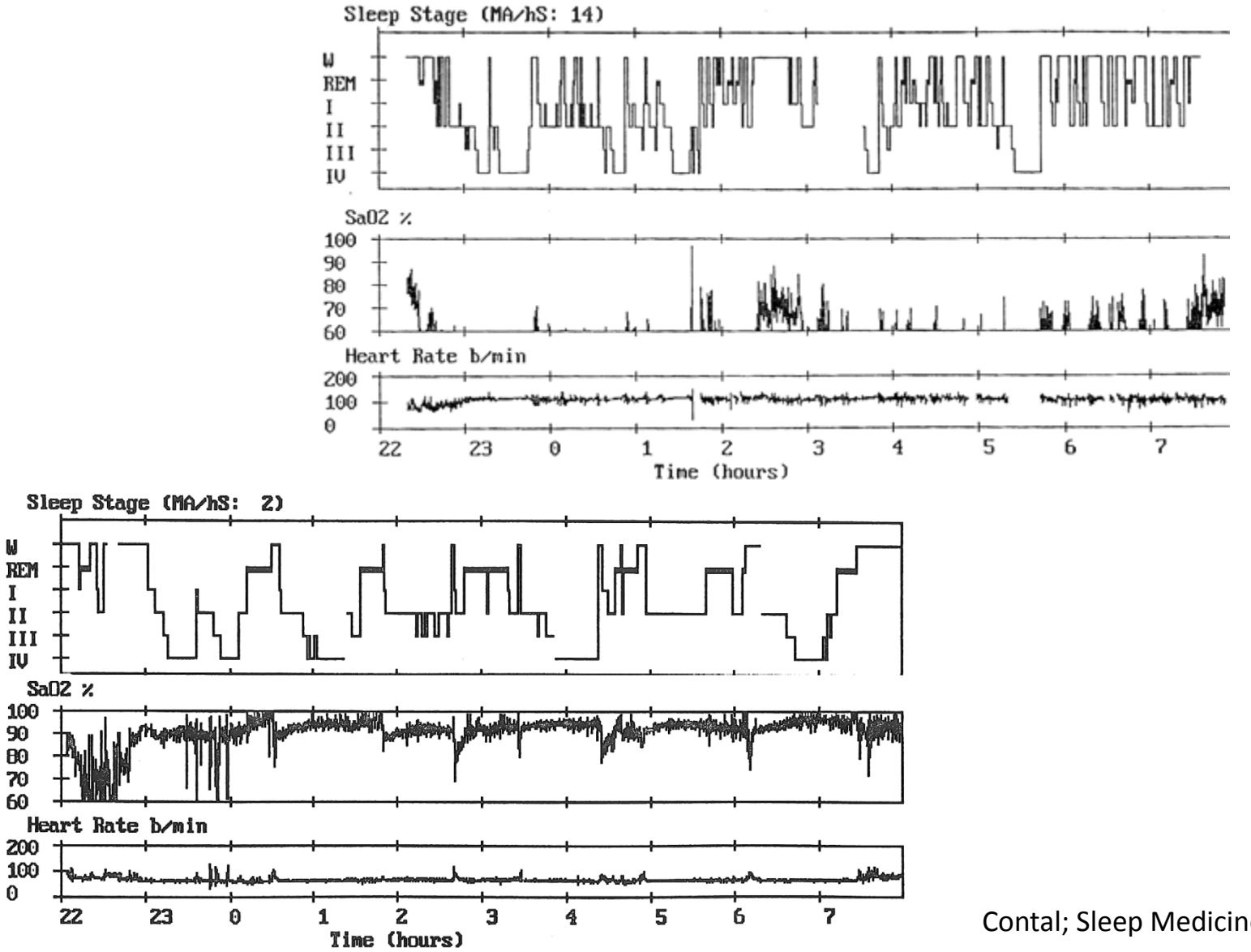
- vidéo

Répercussions de la VNI

	N	Mean before NIV	Mean after NIV	≠ after and before NIV	P Value
Total Sleep Time in min	60	340	343	3	0.82
Sleep efficiency in %	55	64	71	7	0.004
Sleep Latency in min	55	43	28	-15	0.07
REM in min	60	45	66	21	0.005
REM in % of TST	60	12	18	6	0.002
Sleep stage 1 in min	60	73	42	-31	0.001
Sleep stage 1 in % of TST	60	26	14	-12	0.001
SWS in min	55	87	98	11	0.26
SWS in % of TST	55	22	30	8	0.051
Micro Arousal	57	25	14	-11	0.003
Mean of SpO_2 in %	59	85	93	8	< 0.001
Minimum of SpO_2 in %	56	63	77	14	< 0.001
ODI	43	37	13	-24	< 0.001

Contal; Sleep Medicine 2011

VNI et sommeil



Contal; Sleep Medicine 2011

Interactions patient-ventilateur
ventilation asynchronisée

VNI au long cours et asynchronie

Variables	Patients With PVA (n = 11)	Patients Without PVA (n = 9)	p Value†
TST, min	379 ± 64	395 ± 66	NS
Sleep efficiency, %	74.1 ± 11.0	69.1 ± 11.0	NS
Stage 1, %	17.6 ± 5.1	12.4 ± 2.2	0.008
Stage 2, %	56.2 ± 9.4	46.2 ± 9.5	0.031
Slow wave sleep, %	15.0 ± 10.0	23.6 ± 8.4	0.05
REM sleep, %	11.3 ± 3.3	17.9 ± 6.9	0.022
AHI, /h	5.1 ± 4.5	5.4 ± 5.9	NS
ODI, /h	7.6 ± 7.5	5.4 ± 5.0	NS
MAI, /h	30 ± 8	21 ± 9	0.032
Minimal Spo_2, %	79 ± 7	80 ± 6	NS
Mean Spo_2, %	90 ± 3	91 ± 3	NS
Mean $TcPco_2$, mm Hg	45 ± 6	43 ± 6	NS
Median $TcPco_2$, mm Hg	45 ± 6	44 ± 6	NS

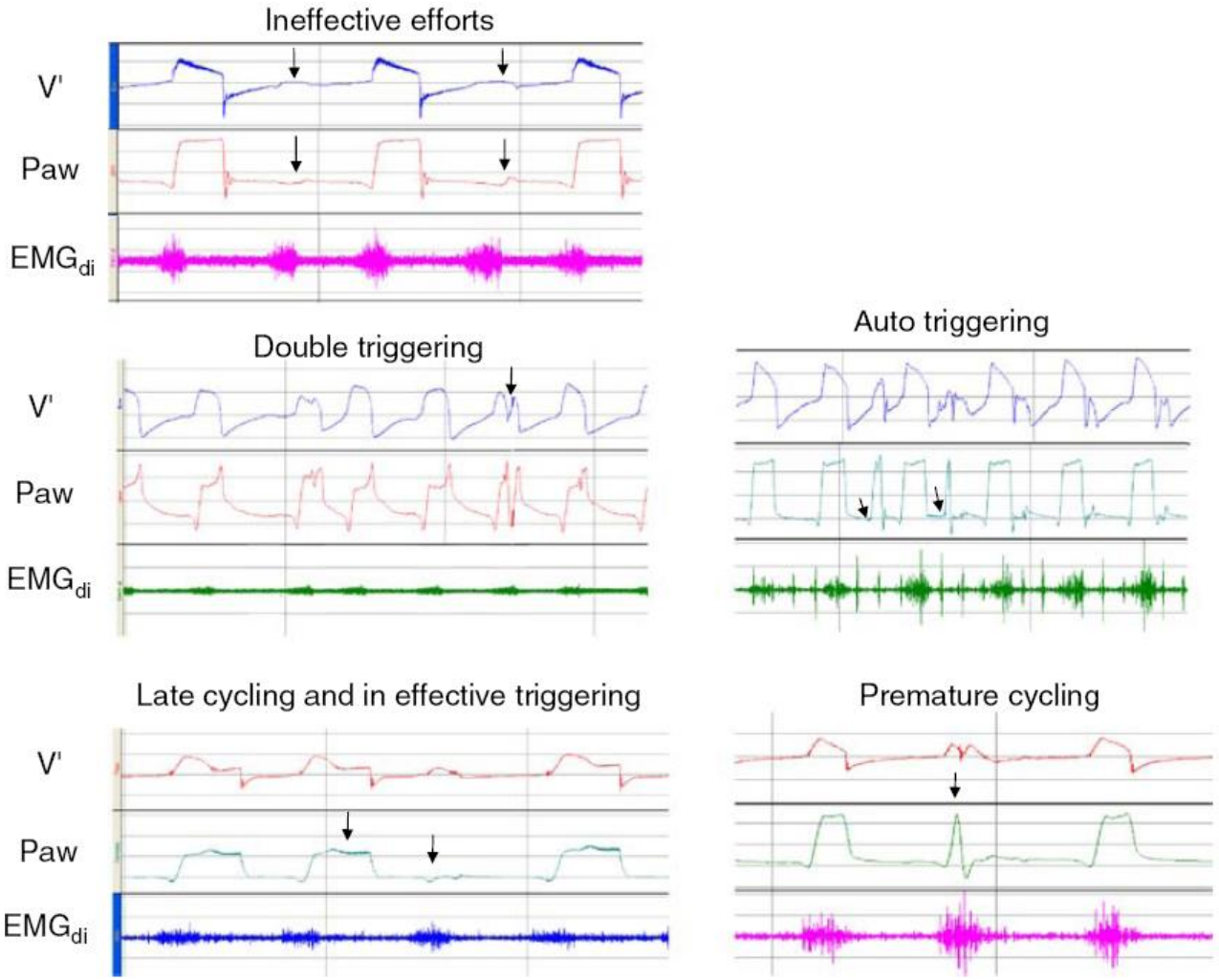
Guo; Chest 2007

Interactions patient-ventilateur aux SI

- 60 patients inclus
- Observation d'événements respiratoires lors de la mise en place de la VNI
- VNI avec ventilateurs de réanimation

Vignaux; ICM 2009

Différentes interactions



Vignaux; ICM 2009

Conséquences des asynchronies

Table 4 Asynchrony events and respiratory parameters

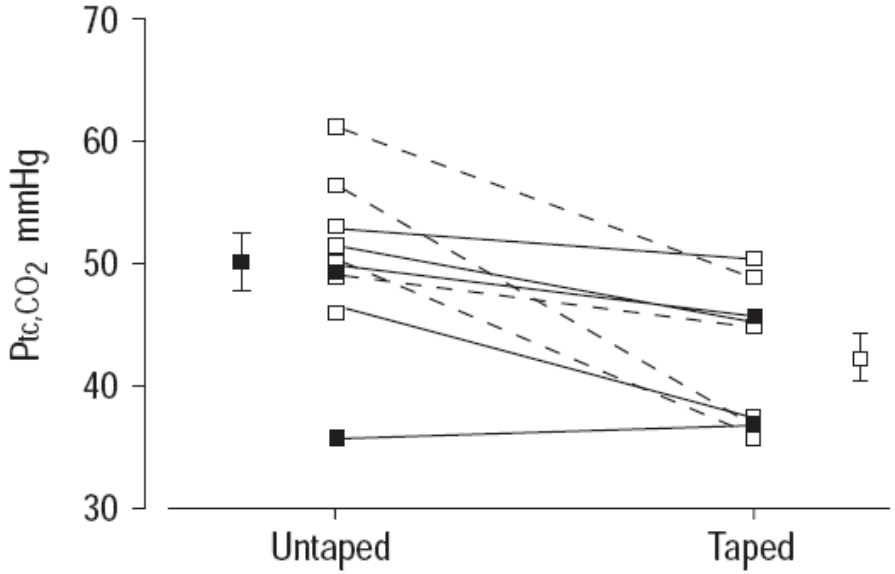
	Ineffective efforts		Auto- triggering		Double-triggering		Premature cycling		Late cycling		AI > 10%	
	Absent ($n = 52$)	Present ($n = 8$)	Absent ($n = 48$)	Present ($n = 12$)	Absent ($n = 51$)	Present ($n = 9$)	Absent ($n = 53$)	Present ($n = 7$)	Absent ($n = 46$)	Present ($n = 14$)	Absent ($n = 34$)	Present ($n = 26$)
VTe												
(ml)	516 (22)	346 (52)*	504 (23)	452 (55)	489 (22)	523 (44)	483 (21)	570 (91)	517 (25)	419 (27)	508 (25)	475 (37)
(ml/kg)	7.6 (2.8)	3.9 (1.9)*	7.2 (3.3)	6.6 (3.1)	6.9 (2.8)	8.2 (4.1)	6.7 (2.5)	10.4 (4.3)*	7.6 (3.1)	5.7 (3.1)*	7.8 (2.5)	7.2 (3.6)
MVe (l/min)	12.8 (0.6)	8.3 (1.2)*	12.4 (0.7)	11.1 (1.5)	12.1 (0.7)	12.9 (1.7)	12.2 (0.6)	12.1 (1.7)	13.0 (0.7)	9.5 (0.48)*	13.1 (0.8)	10.9 (0.8)*
RR (/min)	25 (0.9)	25 (1)	25 (0.8)	25 (2)	25 (0.8)	26 (3)	25 (0.8)	22 (3)	25 (1)	23 (1)	26 (1)	24 (1)
Leak												
(l/min)	3.5 (0.4)	4.5 (1.2)*	3.4 (0.4)	6.1 (1.7)*	4.2 (0.6)	3.9 (0.9)	4.3 (0.6)	3.7 (0.9)	3.4 (0.4)	5.2 (1.5)*	3.1 (0.5)	5.7 (0.9)*
(%)	27.3	54.2	47.2	54.9	34.7	30.2	35.2	30.5	26.1	54.7	23.6	52.3
ti_p (ms)	796 (45)	773 (47)	786 (47)	820 (63)	758 (22)	992 (23)*	752 (23)	1,100 (28)*	791 (50)	800 (39)	730 (27)	874 (82)*
ti_{excess} (ms)	32 (3)	61 (5)*	37 (5)	30 (3)	40 (4)	15 (4)*	40 (4)	1 (7)	28 (3)	62 (9)*	34 (4)	38 (8)
PSL (cmH_2O)	11 (0.5)	12 (1.1)	11 (0.6)	11 (1.3)	12 (0.5)	8 (1.4)*	11 (1.5)	12 (1.1)	11 (0.6)	12 (1.1)	10 (0.6)	12 (0.8)

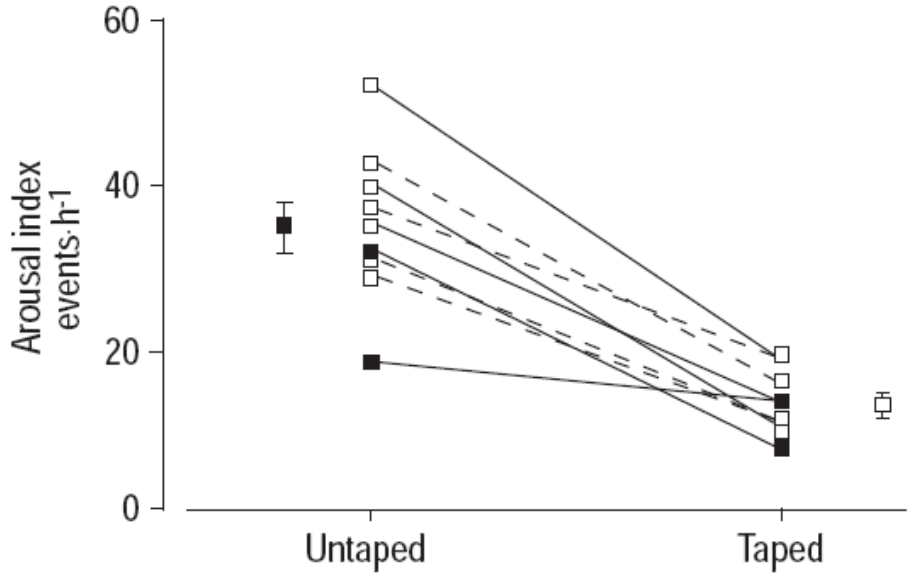
Vignaux; ICM 2009

VNI et FUITES

Interactions patient-ventilateur et fuites

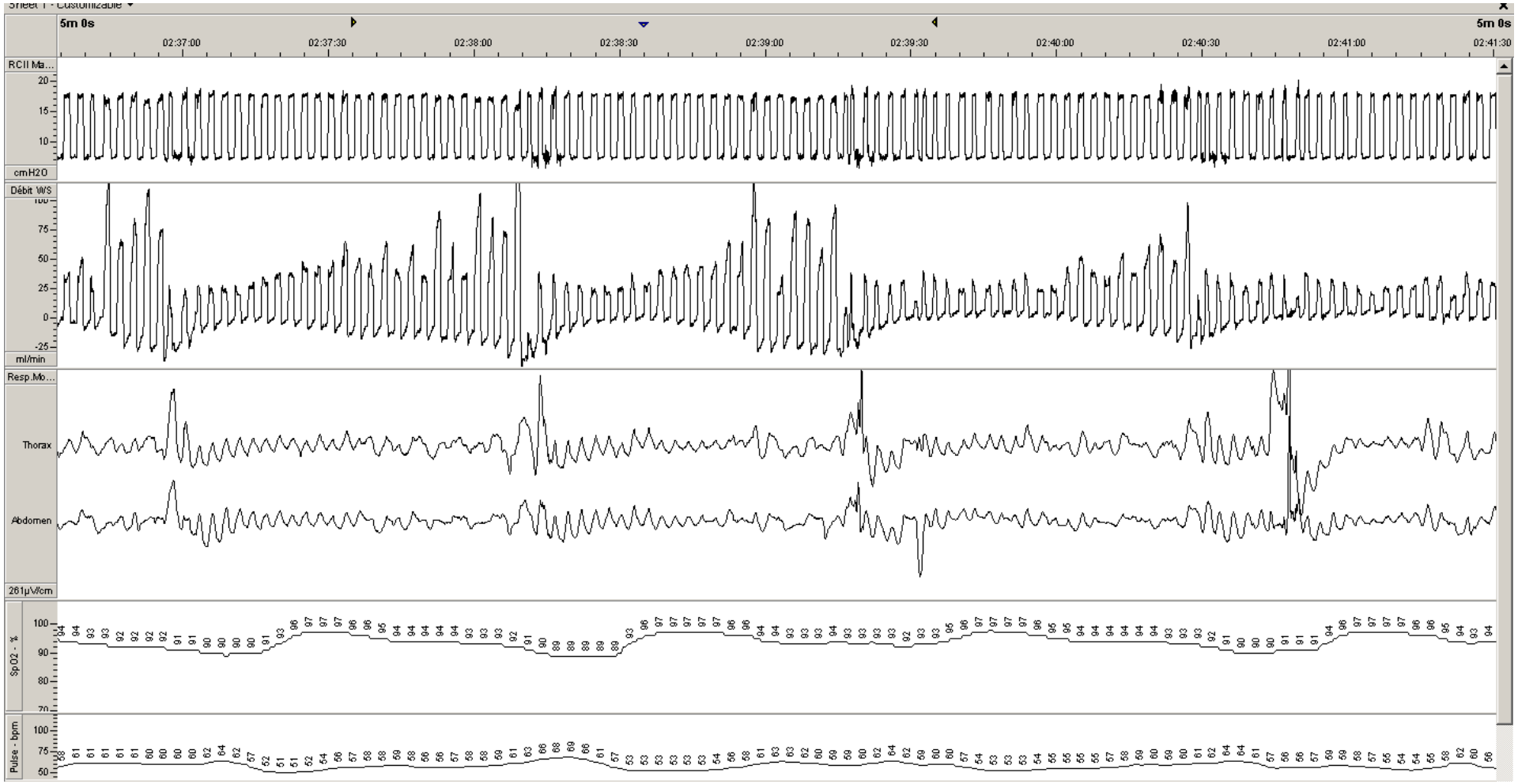
	Control	Taped	Delta	p-value
Leak $L \cdot s^{-1}$				
25th centile	0.08±0.01	0.03±0.02	-0.05±0.02	0.05
Median	0.35±0.07	0.06±0.03	-0.29±0.08	0.008
75th centile	0.61±0.08	0.09±0.04	-0.52±0.09	0.0005



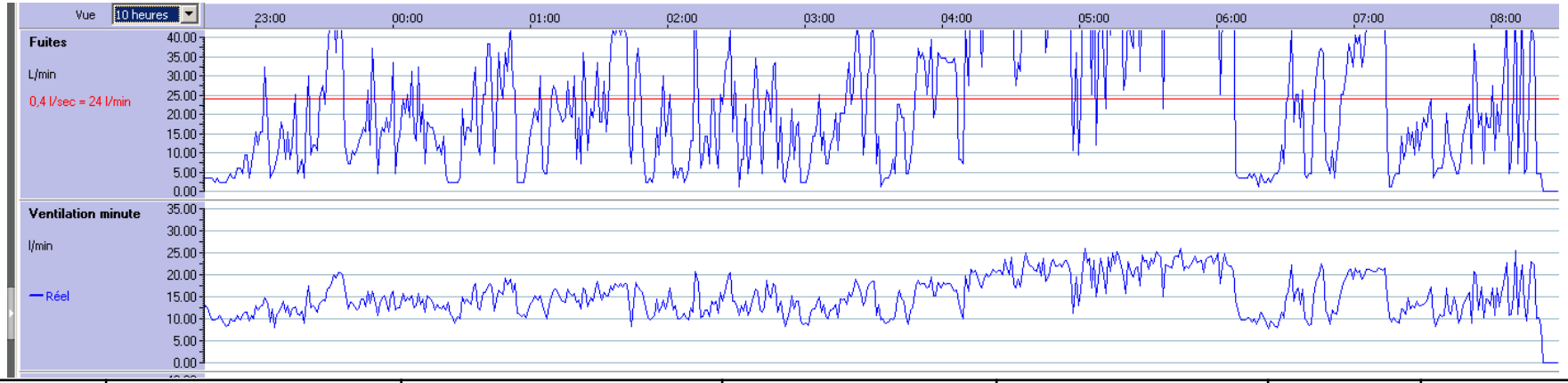


Teschler; ERJ 1999

Fuites et signaux respiratoires



Monitoring des fuites



	Ventilator	Average Leaks (SD) (L/min)	Bias (SD) (L/min)	Upper and lower limits of agreement (L/min)	R^2	P value
A	Monnal T30	63.8 (10.9)	-8.3 (6.1)	[-20.3 ; 3.7]	0.701	0.003
B	Synchrony	50.5 (11.9)	-6.0 (3.2)	[-12.3 ; 0.3]	0.957	<0.001
C	Trilogy	58.5 (13.6)	0.3 (1.0)	[-1.7 ; 2.3]	0.997	<0.001
D	Ventimotion	58.2 (20.8)	-16.3 (5.2)	[-26.5 ; -6.1]	0.987	<0.001
E	Vivo 40	54.8 (10.5)	-25.9 (12.7)	[-50.8 ; -1.0]	0.829	<0.001
F	VPAP III	14.6 (12.7)	0.8 (1.5)	[- 2.1 ; 3.7]	0.993	<0.001
G	VPAP IV	14.8 (12.5)	0.9 (0.9)	[-0.9 ; 2.7]	0.995	<0.001

Contal; Chest 2012

Ventilation nocturne avec fuites

- vidéo

Aide Inspiratoire

Interactions patient-ventilateur et AI

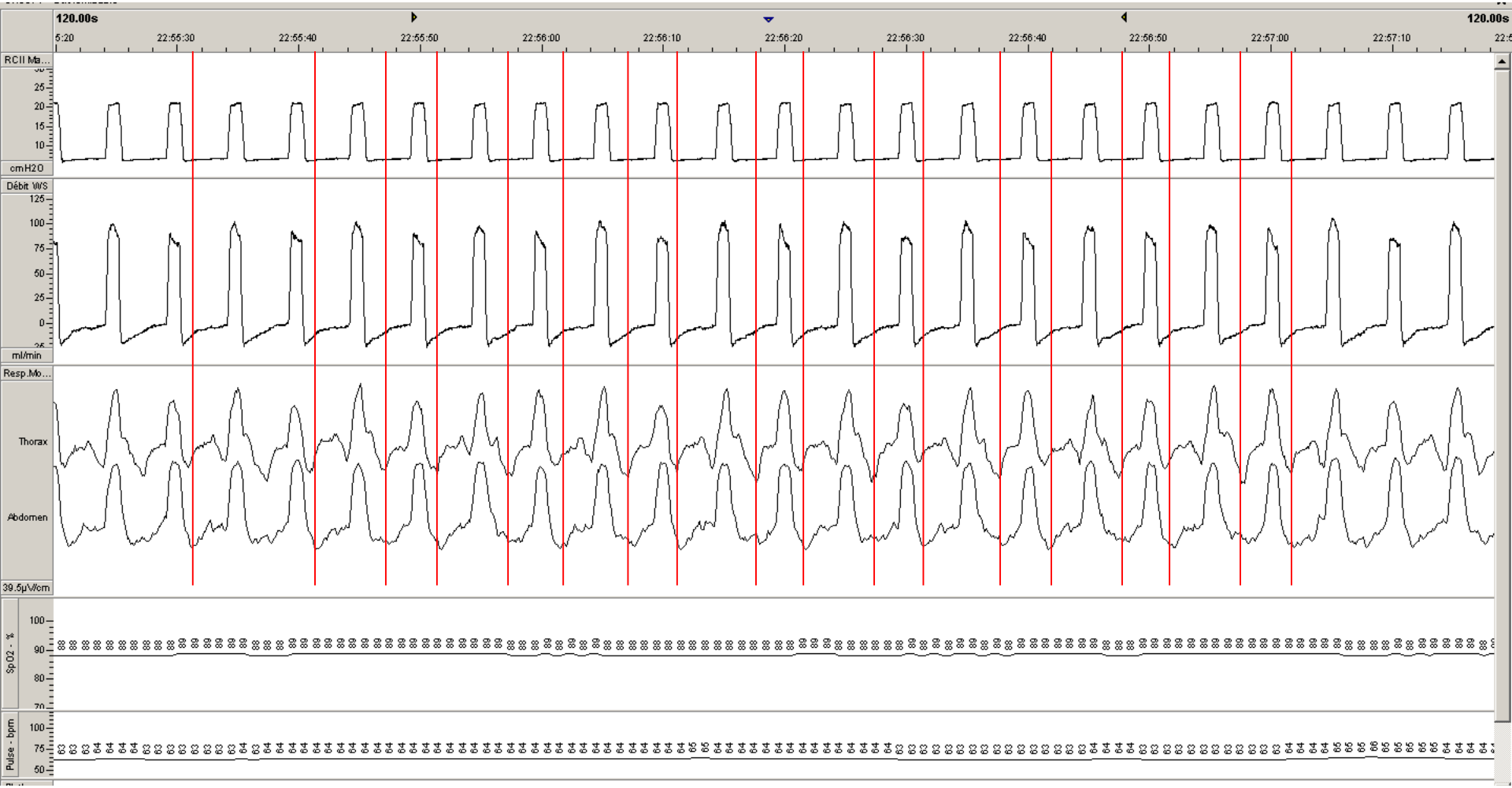
- 8 patients BPCO
- 1ière nuit VNI standard
  - EPAP 5.4 ± 1.3 cmH_2O
  - PS 19 ± 2 cmH_2O
- 2ième nuit VNI adaptée
  - EPAP 6.3 ± 1.8 cmH_2O
  - PS 16.5 ± 2 cmH_2O

- vidéo

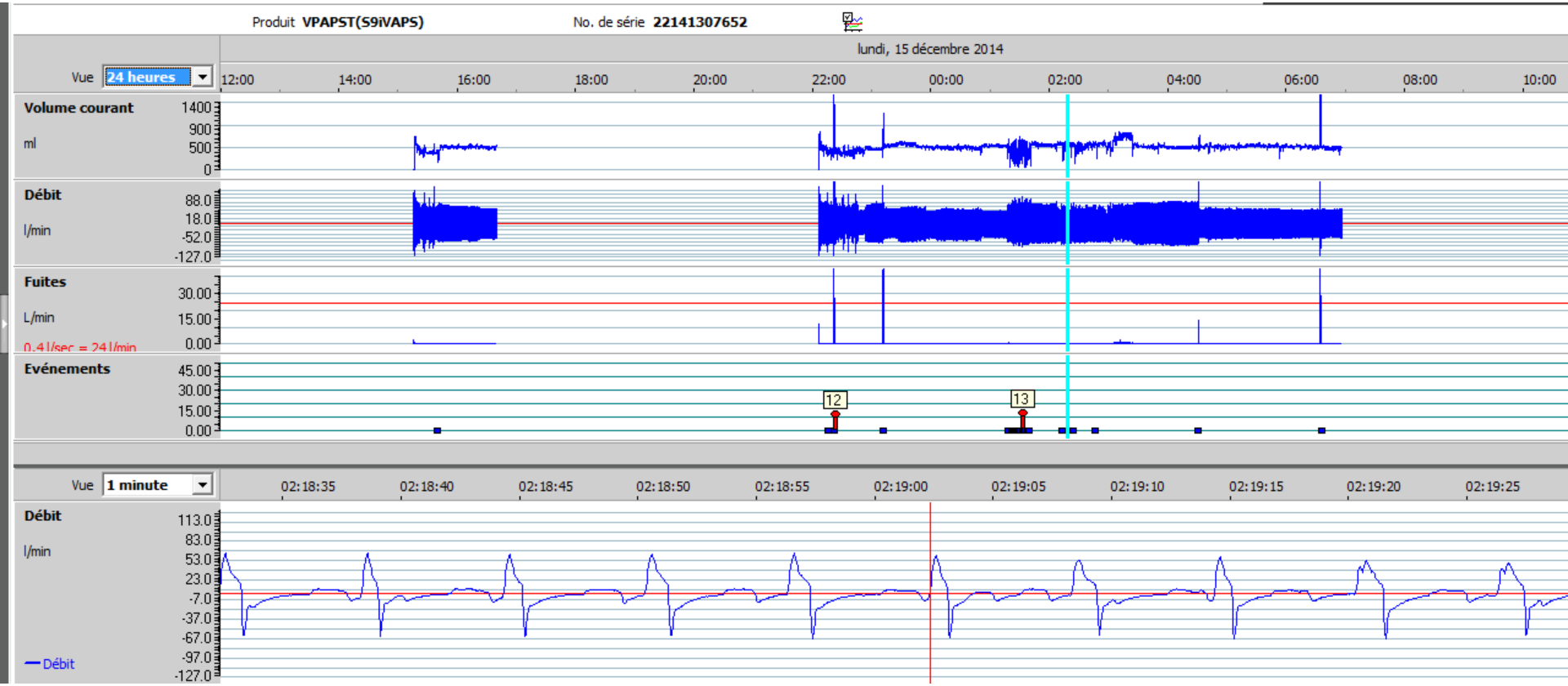
Courtesy D. Adler

Adler D. Sleep Breath 2011

Cycles non récompensés



Cycles non récompensés

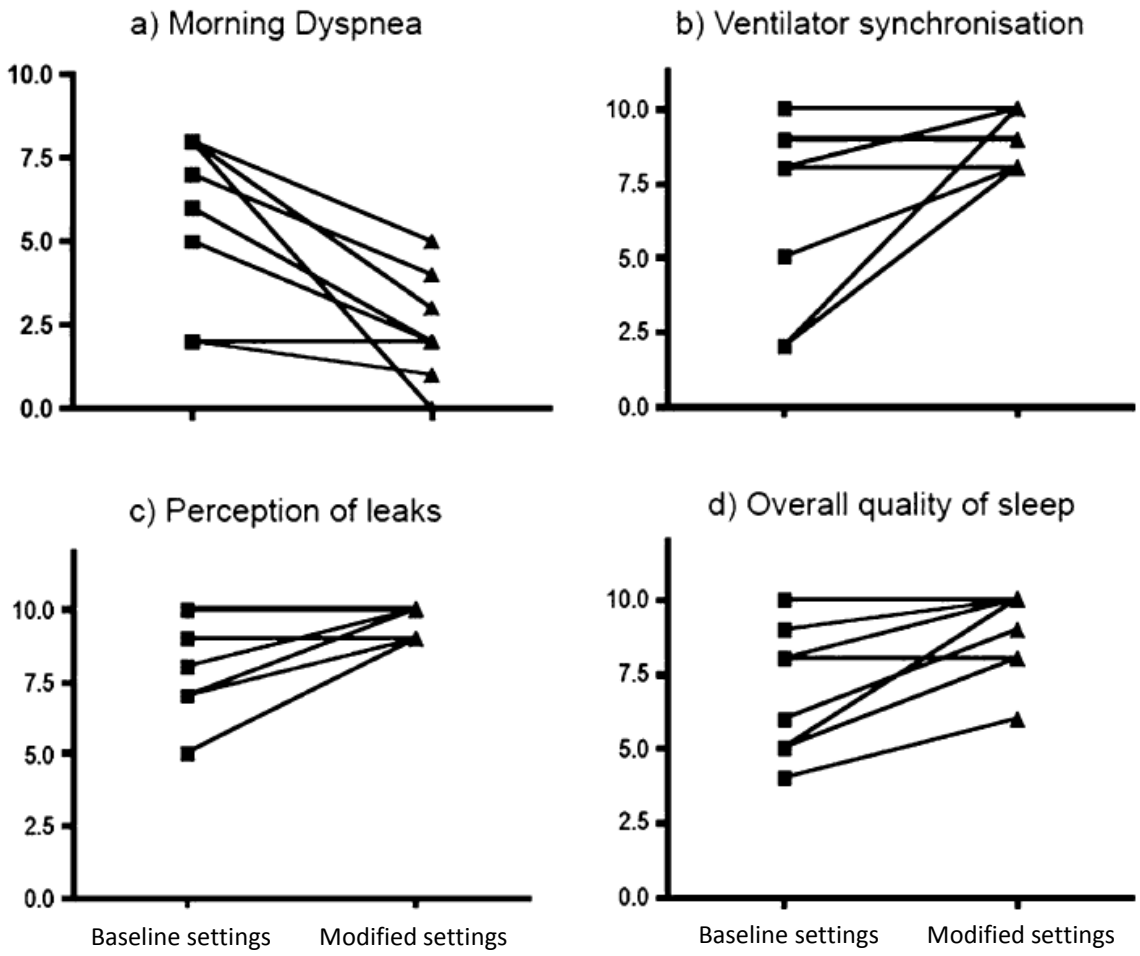


Dyspnée de déventilation

- vidéo

Courtesy D. Adler

Répercussions de l'adaptation des réglages



Adler D. Sleep Breath 2011

Fréquence de rattrapage

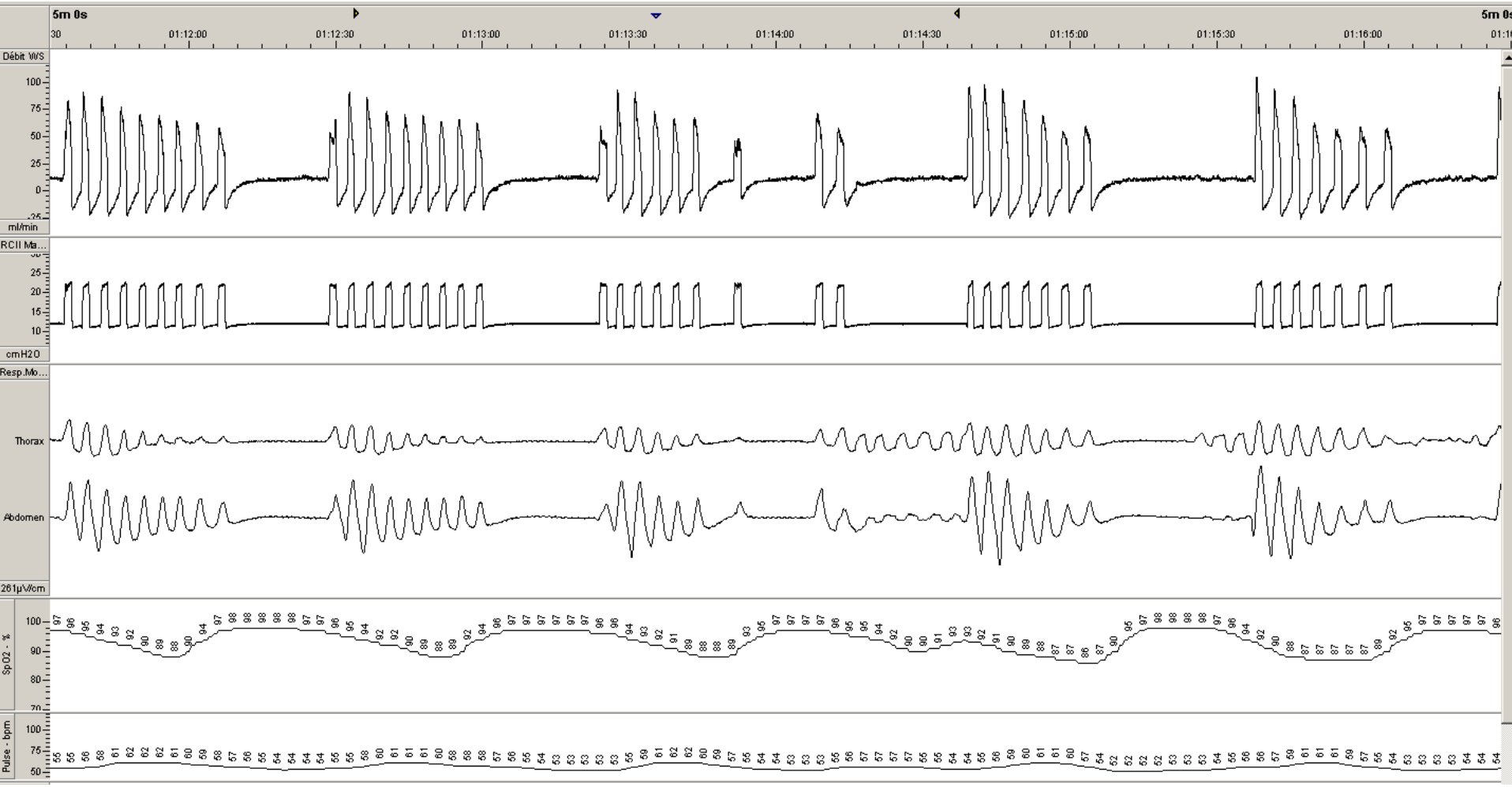
Interactions patient-ventilateur et FR

- Comparer
  - La ventilation spontanée (sans FR)
  - FR basse (10.9±0.9/min)
  - FR haute (20.5±1.5/min)

- Résultats étudiés:
  - Structure du sommeil évaluée par polysomnographie (PSG)
  - Hypoventilation mesurée par $TcPCO_2$
  - Événements respiratoires: événements obstructifs, centraux et mixtes, PVA
  - Qualité du sommeil avec 2 questionnaires

Contal, Chest 2013

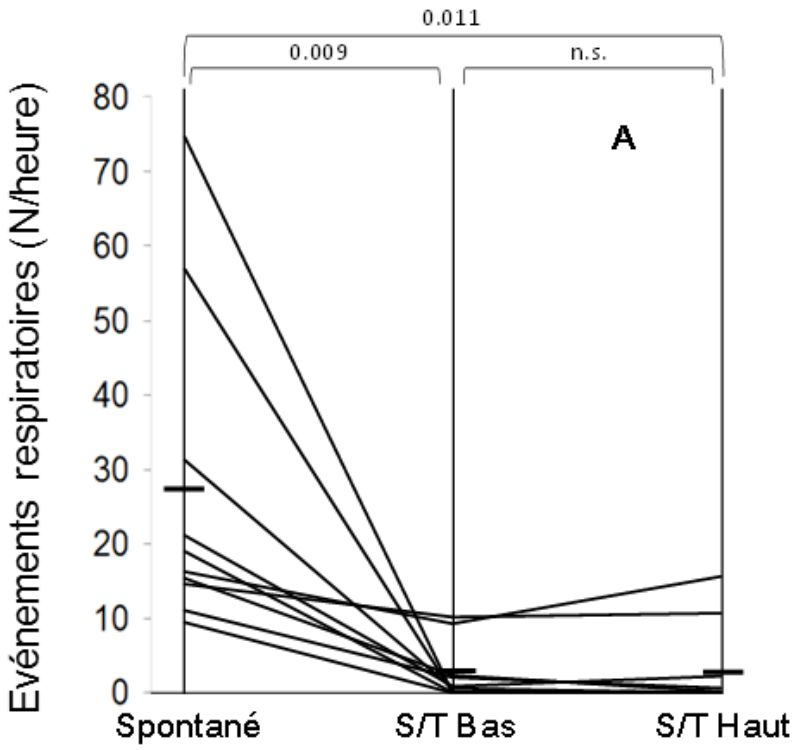
Événements respiratoires sans FR



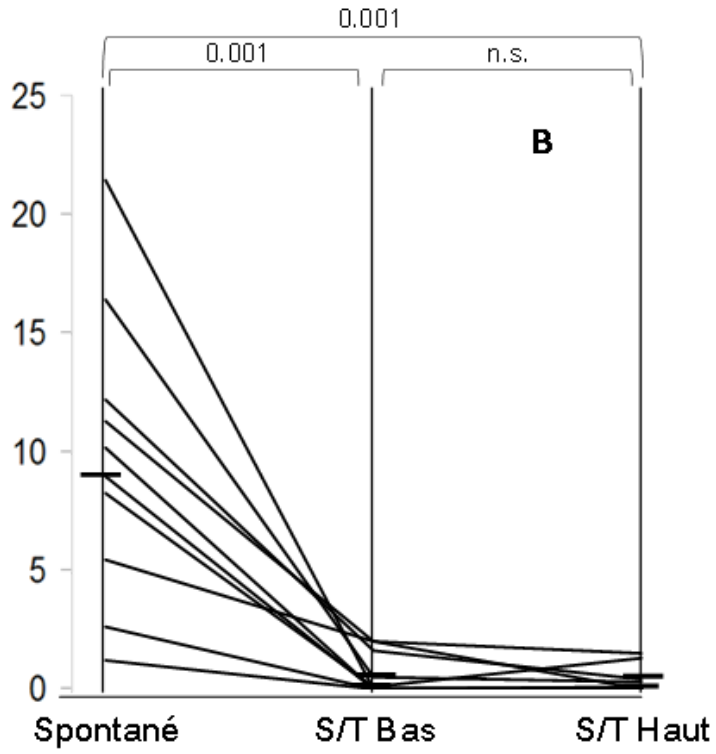
Contal, Chest 2013

FR et événements centraux

- La principale conclusion de ce travail est l'index très élevé d'événements centraux et mixtes en l'absence de FR



A: Evénements centraux

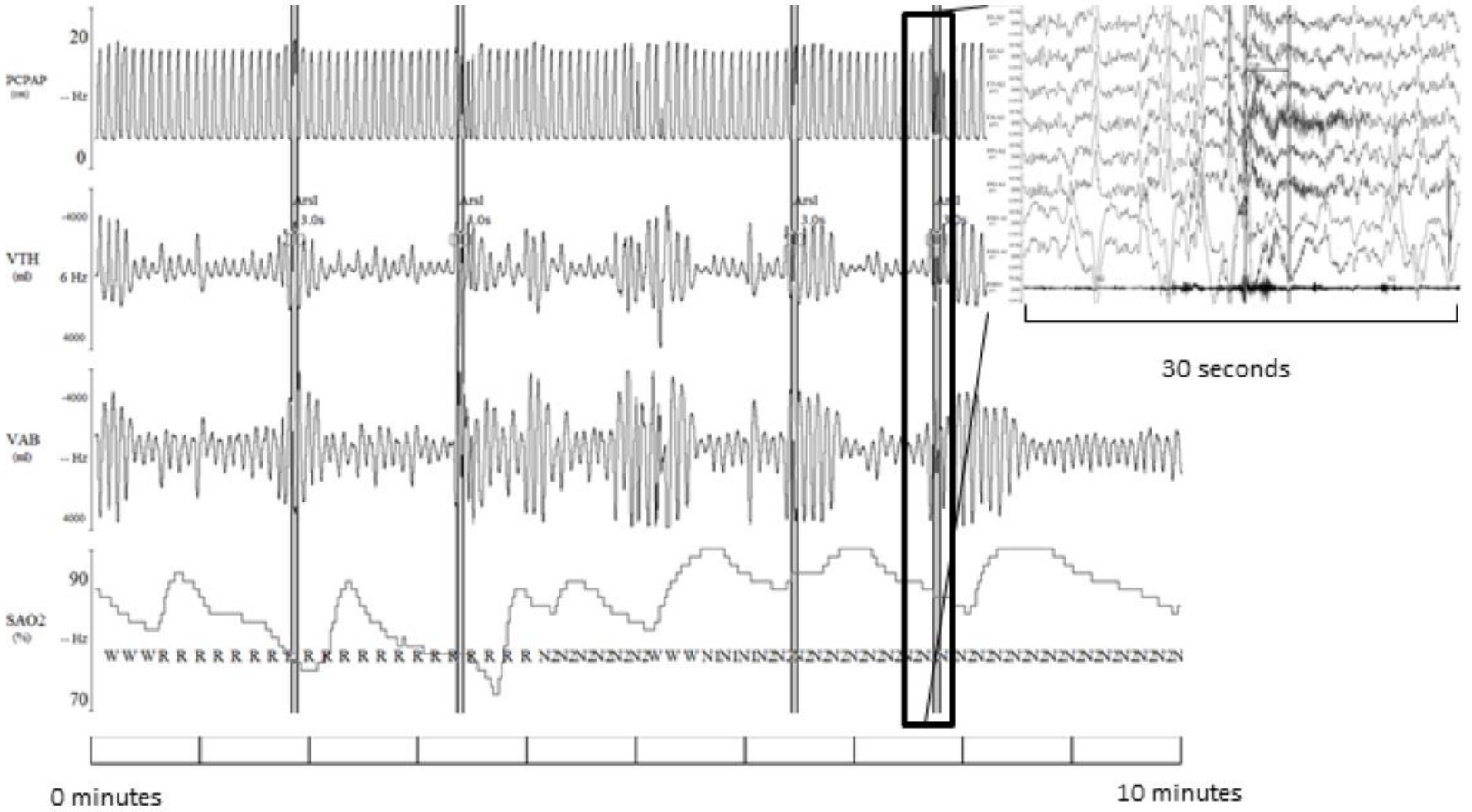


B: Evénements mixtes

Contal, Chest 2013

Masques et asynchronies

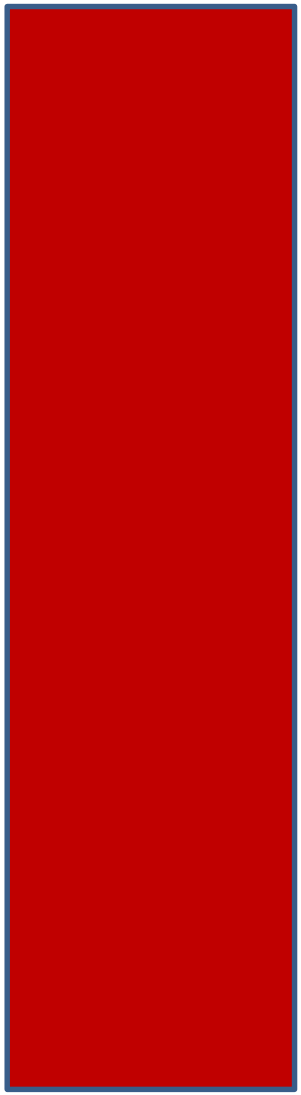
Evénements respiratoires induits et masque facial



Vrijsen, JCSM 2014

Evénements respiratoires induits et masque facial

	Night 1 (310 min with NIV)
Mask	Oronasal
Mode	S/T
IPAP (cmH_2O)	16
EPAP (cmH_2O)	4
Fmin (/min)	12
Ti (s)	1.8
Sleep Efficiency (%)	85.4
Arousal Index (/h sleep)	23.8
Arousal Awake Index (/h sleep)	26.4
Apnea-Hypopnea Index (/h sleep)	Total sleep: 33.7 REM sleep: 46.9
SpO_2% mean (%)	Total sleep: 86.4 REM sleep: 81.2
SpO_2% < 90% (%)	Sleep 1+2: 64.2 Slow wave sleep: 72.9 REM sleep: 93.9
$P_{tc}CO_2$ maximum (mmHg)	75
$P_{tc}CO_2$ < 50 mmHg (%)	1.3 *



Vrijsen, JCSM 2014

Evénements respiratoires induits et masque facial

	Night 1 (310 min with NIV)	Night 2
Mask	Oronasal	Nasal
Mode	S/T	S/T
IPAP (cmH_2O)	16	12
EPAP (cmH_2O)	4	4
Fmin (/min)	12	15
Ti (s)	1.8	1.6
Sleep Efficiency (%)	85.4	83.4
Arousal Index (/h sleep)	23.8	10.1
Arousal Awake Index (/h sleep)	26.4	17.1
Apnea-Hypopnea Index (/h sleep)	Total sleep: 33.7 REM sleep: 46.9	Total sleep: 2.6 REM sleep: 2.0
SpO_2% mean (%)	Total sleep: 86.4 REM sleep: 81.2	Total sleep: 92.9 REM sleep: 93.6
SpO_2% < 90% (%)	Sleep 1+2: 64.2 Slow wave sleep: 72.9 REM sleep: 93.9	Sleep 1+2: 0 Slow wave sleep: 0 REM sleep: 0.5
$P_{tc}CO_2$ maximum (mmHg)	75	55
$P_{tc}CO_2$ < 50 mmHg (%)	1.3*	72.0

Vrijsen, JCSM 2014

Conclusion