VENTILATON EN BILVEL DANS LE SDRA

PR AG YOUSSEF ZIED ELHECHMI

RÉANIMATION

ATR – NOVEMBRE 2019 – RADISSON BLU, HAMMAMET

ÉPIDÉMIOLOGIE

- Incidence en Réanimation : 7%-9%
- Mortalité : 40% (34% léger, 40% modéré, 46% sévère)
- 25% des malades ventilés en Réanimation

LA VENTILATION PROTECTRICE AU COURS DU SDRA

- La ventilation protectrice à amélioré de manière significative la mortalité dans le SDRA :
  - **Vt : 6 ml/Kg**
  - Plateau ≤ 28 cmH2O
  - Optimisation de la PEEP et de la Driving Pressure

ntilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. The Acute Respiratory Distress
Network N Engl J Med 342: 1301-13

PROTECTRICE MAIS…

- Faibles Vt => Hypercapnie Acidose => FR plus élevée => Besoin d'une sédation profonde
- PEEP élevées augmentent le risque de surdistention et de barotraumatisme
- ➔Besoin d'utilisation d'une sédation profonde voire d'une curarisation

PROTECTRICE MAIS…

- Tout ce qui précède va avoir comme conséquences :
  - ↑ Durée de la ventilation mécanique
  - ↑ Durée de séjour en Réanimation
  - ↑ Risque nosocomial (PAVM…)
  - ↑ Incidence des neuropathies périphériques
  - Prédispose au délirium

Ely, E. W. et al. Delirium as a predictor of mortality in mechanically ventilated patients in the intensive care unit. JAMA 291, 1753–17
Schweickert, W. D. et al. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. Lancet 373, 1874–18
Deborah J. Cook, MD et al. Incidence of and Risk Factors for Ventilator-Associated Pneumonia in Critically Ill Patients. Ann Intern Med 129(6):433-4

PROTECTRICE MAIS…

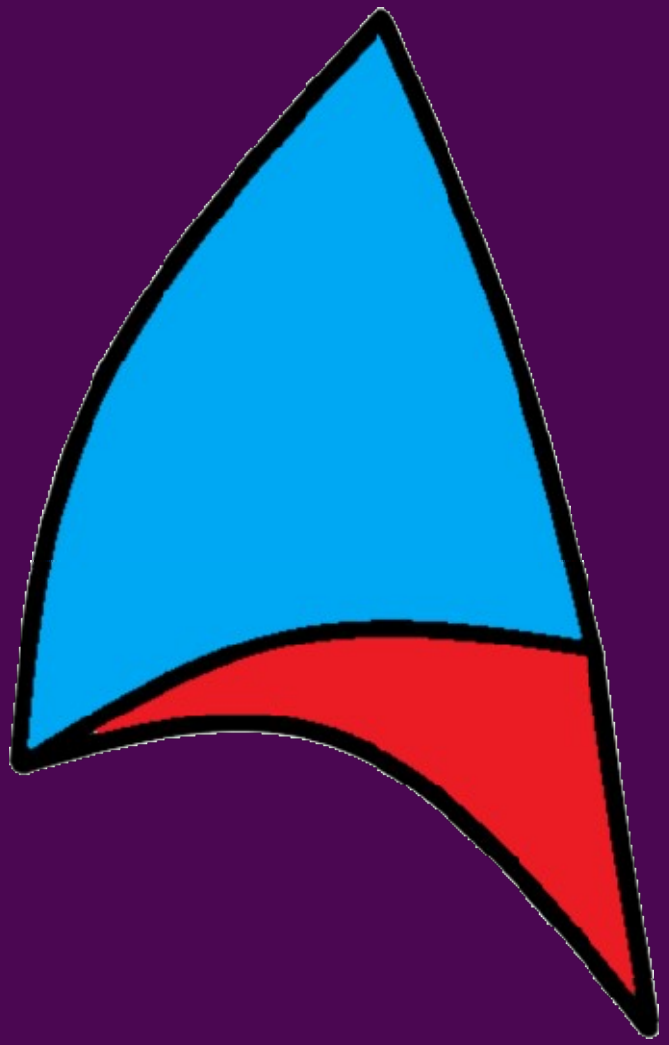
- Physiopath :
  - L'amyotrophie diaphragmatique
    - Débute à H12
    - Baisse significative de la force contractile du diaphragme qui peut atteindre les 46%
    - Aggravé par le sepsis, la dénutrition et l'œdème tissulaire au niveau diaphragmatique

Vassilakopoulos T, Petrof BJ: Ventilator-induced diaphragmatic dysfunction. Am J Respir Crit Care Med 169: 336-3
ns G et al. Increased duration of mechanical ventilation is associated with decreased diaphragmatic force: a prospective observational study. Crit Care 14: R127. 10.1186/cc90
Hussain SN et al. Mechanical ventilation-induced diaphragm disuse in humans triggers autophagy. Am J Respir Crit Care Med 182: 1377-13

PHYSIOLOGIQUEMENT DEUX POUMONS…

Dérecrutement massif du « poumon spontané »

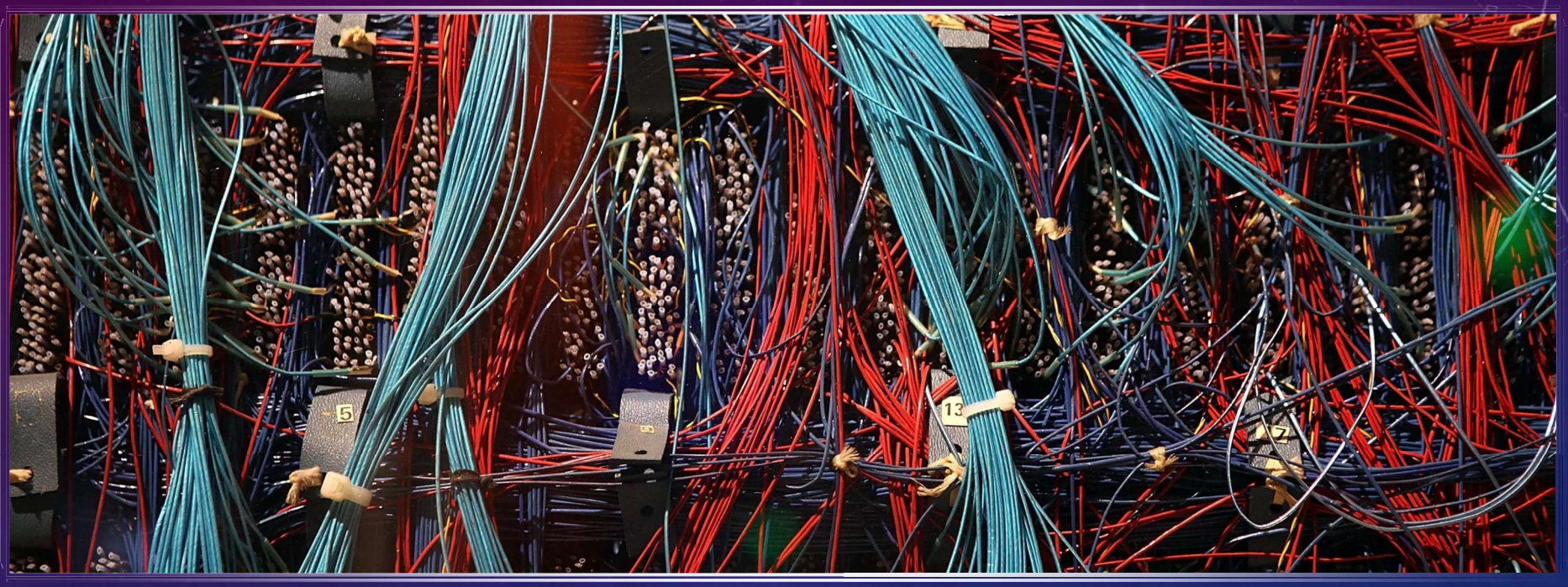
Surdistention du « poumon mécanique »



SO….EVERYTHING IS NOT GREEN IN PARADISE…

LA SOLUTION RÉSIDE T-ELLE DANS LE MODE BILEVEL (APRV+SB)

- Qu’est ce que le BiLevel réellement ?



WHAT IS THE BILEVEL VENTILATION MODE ?

For the intern

WHAT IS THE BILEVEL VENTILATION MODE ?

For the patient

WHAT IS THE BILEVEL VENTILATION MODE ?

What actually it is

Pour les connaisseurs, il s’agit du cockpit de navette spatiale avec autant et même plus de précision dans les commandes

P Haute

P haute = P Plateau + 4cm H2O

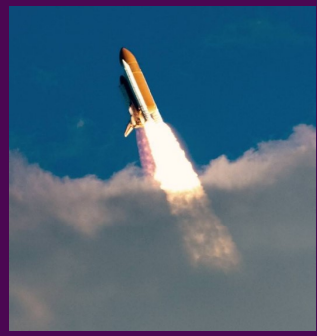
PEEP

allongé de manière à augmenter les chances de survenu des cycles spontanés sur la PHaute.

T PHaute

T PEEP

Limitée par PEEPi…



AI

Adapté au Vt mobilisé…

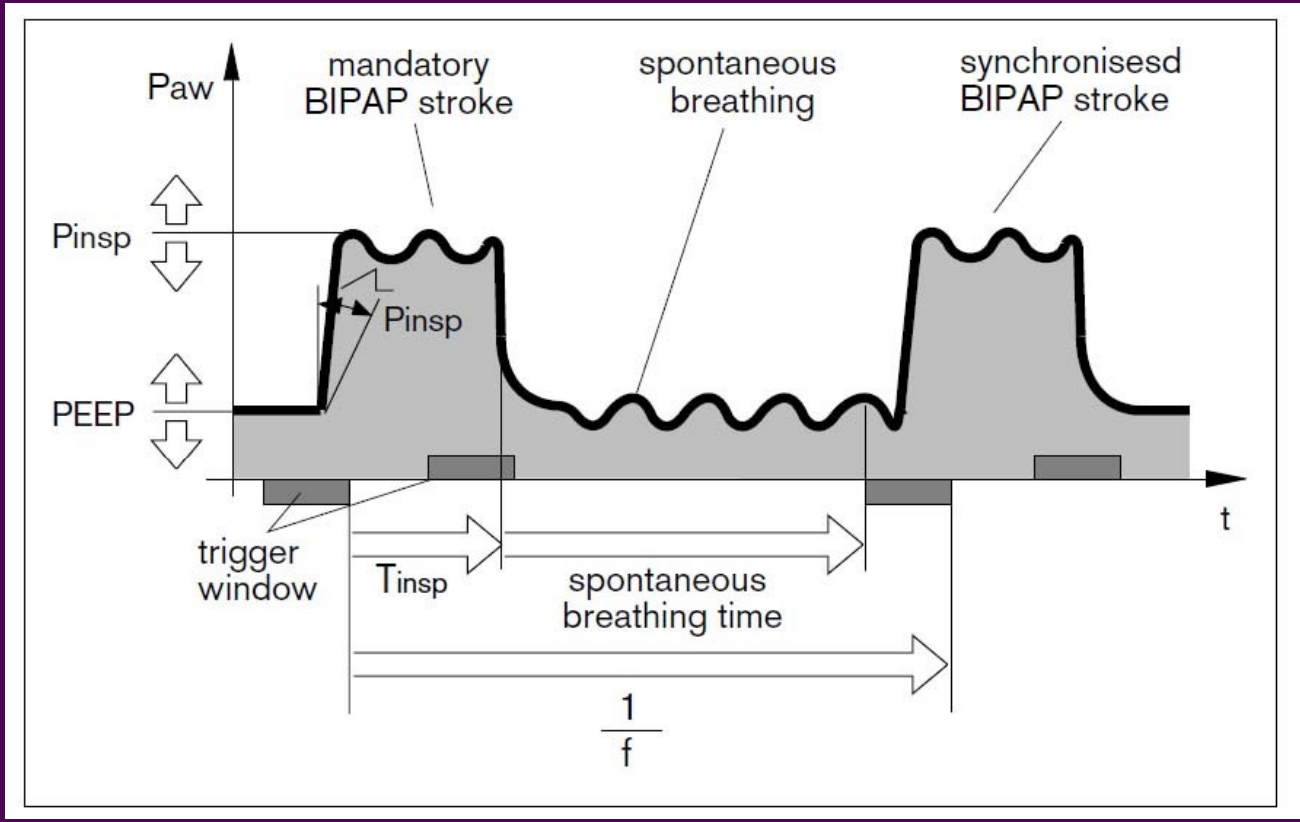
AI

Trig insp

Cycling

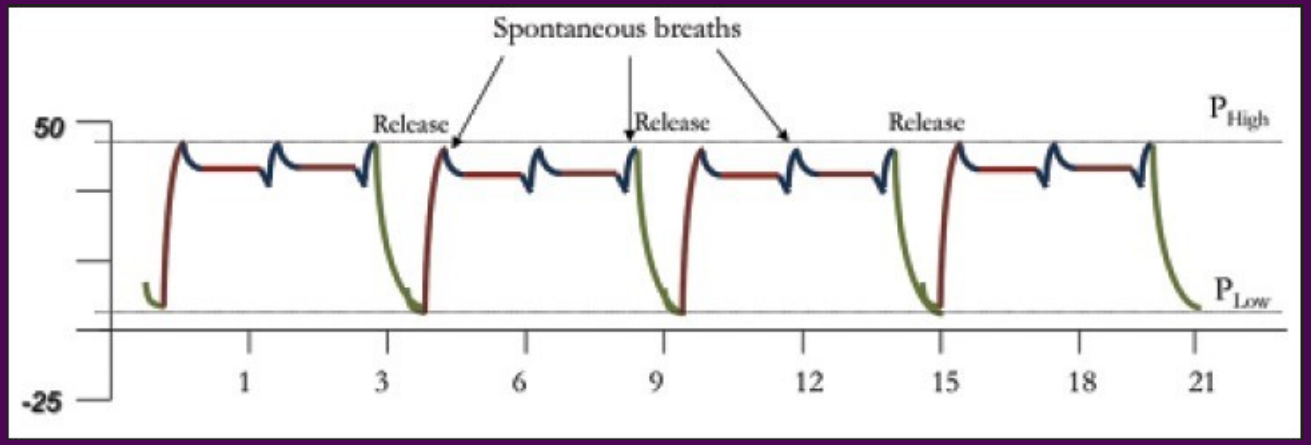
WHAT ARE THE GOALS ?

This is not Bilevel…


Paw
mandatory
BIPAP stroke
spontaneous
breathing
synchronisesd
BIPAP stroke
Pinsp
Pinsp
PEEP
t
trigger
window
Tinsp
spontaneous
breathing time
1
f

WHAT IS THE GOAL ?

>80% of spontaneous cycles occurring during high pressure phase



L’ALARME “PRINCIPALE” DU RESPIRATEUR

- L’alarme la plus importante à déterminer n’es pas une alarme de Pression mais une alarme de Volume !
- Rôle du pH dans la détermination de l’alarme du respirateur…


150
160
170
180
190
200
210
220
230
240
250

BILEVEL SYNONYMS

- Dräger : APRV
- Covidien : Bilevel
- Maquet : Bi-Vent
- Hamilton : DuoPAP/APRV
- General Electric : BiLevel
- Taema : VS-PPV
- Viasys : APRV/BiPhasic

BILEVEL : QU'EST CE QUI L'A RENDU POSSIBLE ?

- Intégration de la ventilation mécanique et de ventilation spontanée avec une réduction importante de l'asynchronie patient-ventilateur.
- Possibilité de détermination de plusieurs paramètres :
  - Deux niveaux de pression (Haute=Pins et basse=PEEP)
  - La durée des 2 niveaux de pression
  - AI, Trig insp, Cycling (Trig exp), temps d'ascension de la Pins et de l'AI

LES BUTS DE LA VENTILATION EN BILEVEL

- Maintenir une activité contractile du diaphragme, permettant de réduire le risque d'amyotrophie
- Ventilation du poumon spontané
- Homogénisation du rapport Ventilation / Perfusion et amélioration du rapport PaO2/FiO2
- Amélioration de l'hémodynamique globale, de la perfusion tissulaire, spécialement rénale, splanchnique, diaphragmatique

SCIENTIFIC EVIDENCES

LES EFFETS RESPIRATOIRES DE LA VENTILATION SPONTANÉE

- Spontaneous ventilation improves « spontaneous lung » ventilation

Table 2. Oxygenation

Parameter	Group	Baseline	Lung Injury	2-h Treatment	4-h Treatment	Lung Injury	Time	Mode	Interaction
Pa_{O_2}, mmHg	SB−	242 ± 18	115 ± 32	90 ± 37	91 ± 50	‡			†
	SB+	240 ± 36	104 ± 41	110 ± 47	144 ± 65§				
Sa_{O_2}, %	SB−	98.9 ± 0.5	95.9 ± 2.3	88.8 ± 11.1	84.0 ± 13.4‖	†	*		*
	SB+	98.6 ± 0.3	91.5 ± 9.9	90.9 ± 9.6	91.3 ± 11.3				
$\dot{D}\ o_2$, ml/min	SB−	365 ± 96	374 ± 64	345 ± 84	339 ± 98				*
	SB+	331 ± 74	365 ± 93	409 ± 111	438 ± 115				
$\dot{V}\ o_2$, ml/min	SB−	142 ± 43	185 ± 36	172 ± 42	160 ± 41	‡			†
	SB+	132 ± 24	172 ± 14	181 ± 29	186 ± 32				
Sv_{O_2}, %	SB−	60.0 ± 7.9	48.3 ± 7.8	44.3 ± 12.6	43.0 ± 11.8	†			*
	SB+	58.3 ± 7.0	46.6 ± 13.7	49.3 ± 10.6	55.3 ± 12.1				
Q_{VA}/Q_T, %	SB−	5.0 ± 1.9	14.4 ± 3.8	24.2 ± 13.4	30.8 ± 18.4‖	‡	*		*
	SB+	5.6 ± 2.9	21.1 ± 13.5	22.7 ± 14.6	21.0 ± 10.9				

Baseline was only tested against Lung Injury. *Post hoc* testing was always performed if a significant F ratio for a factor or the interaction of factors was obtained by repeated-measures analysis of variance (* $P < 0.05$, † $P < 0.01$, ‡ $P < 0.001$), but only significant differences are marked: § $P < 0.05$, ‖ $P < 0.01$, # $P < 0.001$ for within-group differences. and ** $P < 0.05$ for between-group differences (*post hoc* Tukey multiple comparison test).

$\dot{D}o_2$ = oxygen delivery, Pa_{O_2} = arterial oxygen partial pressure, Q_{VV}/Q_T = venous admixture, Sa_{O_2} = arterial oxygen saturation, SB−/SB+ = airway pressure release ventilation *without/with* spontaneous breathing, Sv_{O_2} = venous oxygen saturation, $\dot{V}o_2$ = oxygen consumption.

LA VENTILATION SPONTANÉE AMÉLIORE L'AÉRATION DU « POUMON SPONTANÉE »

Modèle animal de SDRA. 22 specimens. APRV avec et sans VS.

Hermann Wrigge, M.D.; Jörg Zinserling, M.Sc.; Peter Neumann, M.D., Ph.D et al. Spontaneous Breathing Improves Lung Aeration in Oleic Acid–induced L
Anesthesiology 8 2003, Vol.99

LES CYCLES SPONTANÉS AMÉLIORENT LE RAPPORT P/F

VPC vs BiLevel

Sur l'homme

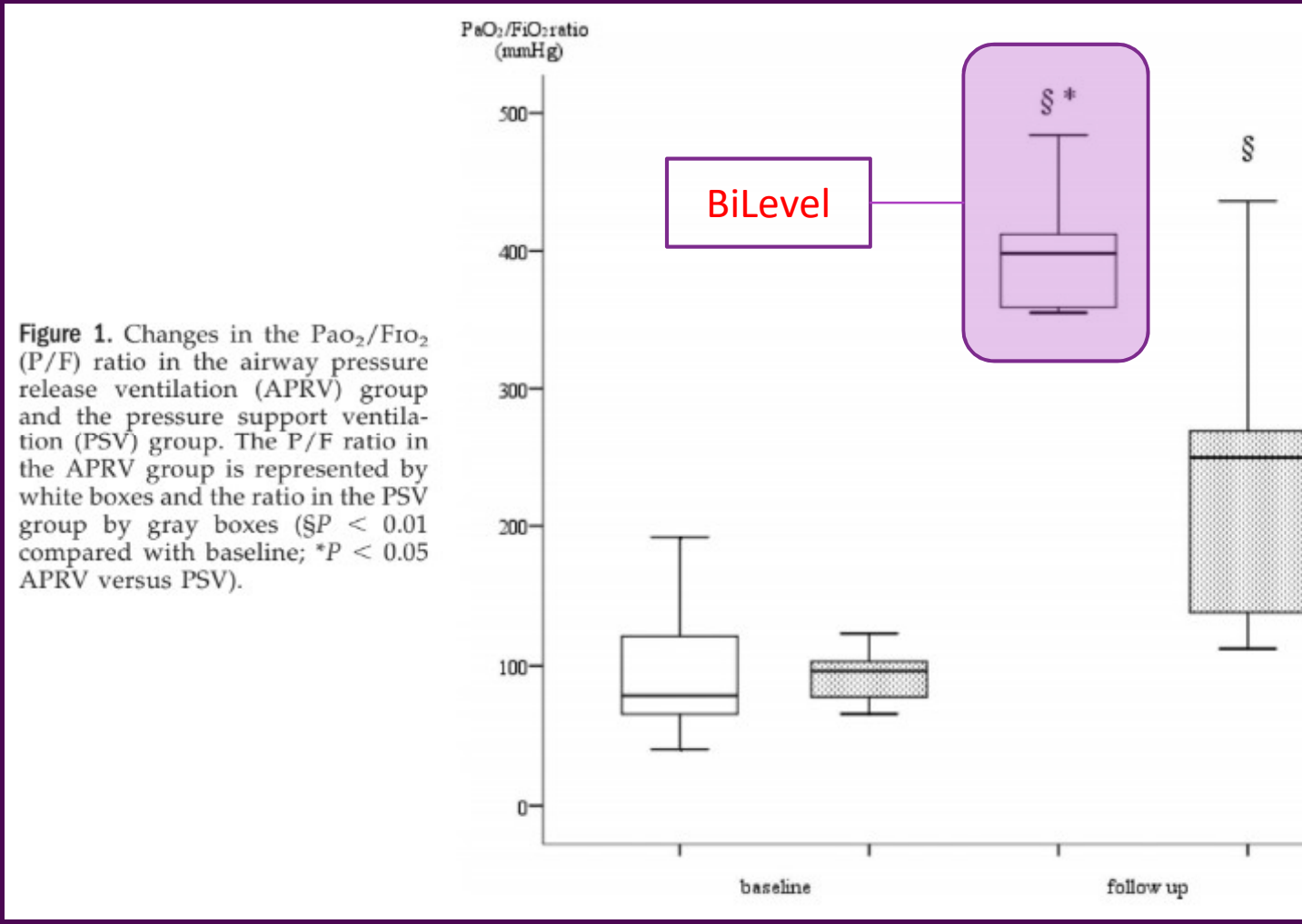
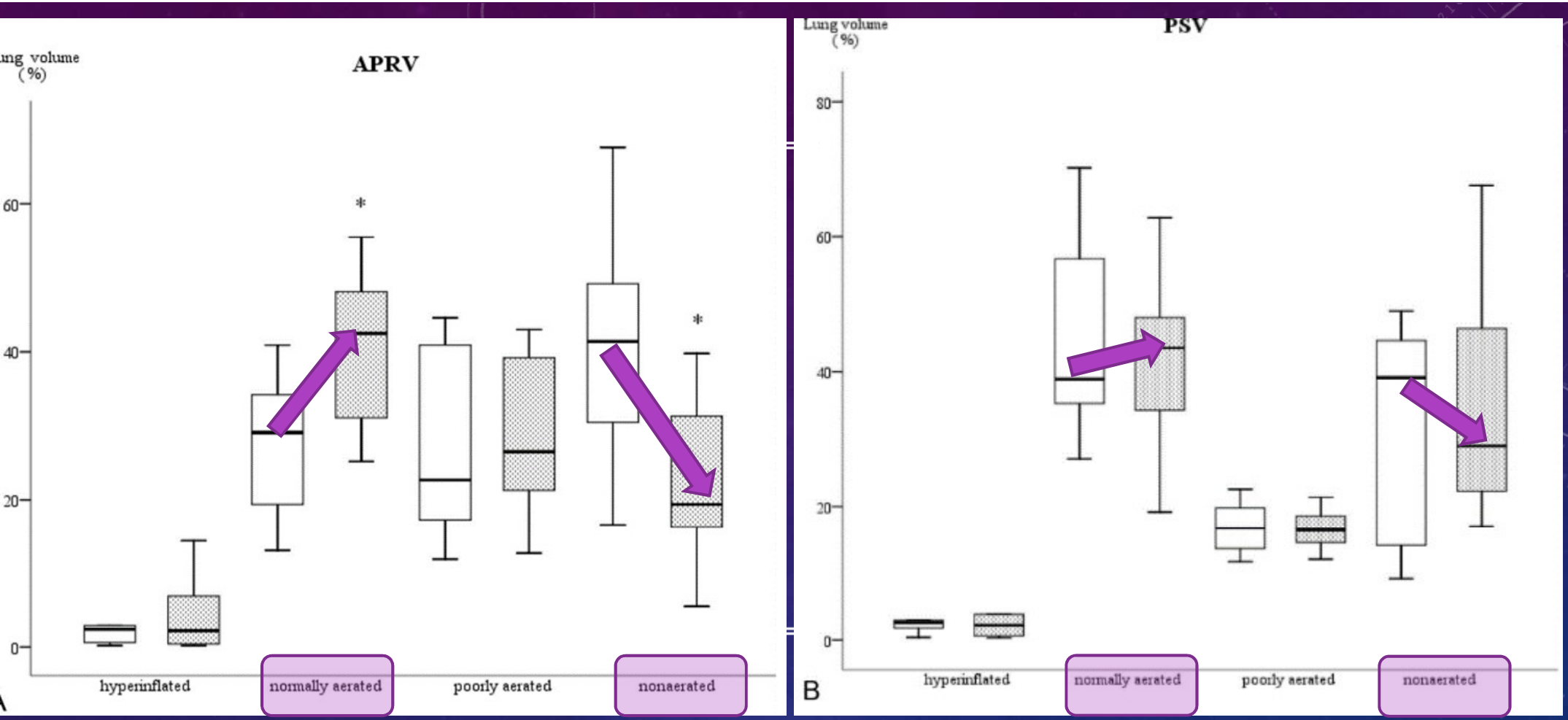


Figure 1. Changes in the Pao_2/Fio_2 (P/F) ratio in the airway pressure release ventilation (APRV) group and the pressure support ventilation (PSV) group. The P/F ratio in the APRV group is represented by white boxes and the ratio in the PSV group by gray boxes (§$P < 0.01$ compared with baseline; *$P < 0.05$ APRV versus PSV).

oshida, MD, Hiroshi Rinka, MD, Arito Kaji, MD et al. The Impact of Spontaneous Ventilation on Distribution of Lung Aeration in Patients with Acute Respiratory Distress Syndror
Pressure Release Ventilation Versus Pressure Support Ventilation. Anesth Analg ;109:1892–9



EFFETS DES CYCLES SPONTANÉS SUR L'AÉRATION ALVÉOLAIRE, LA SURDISTENTION ET LES ATÉLECTASIES

VPC vs Bilevel

oshida, MD, Hiroshi Rinka, MD, Arito Kaji, MD et al. The Impact of Spontaneous Ventilation on Distribution of Lung Aeration in Patients with Acute Respiratory Distress Syndror
Pressure Release Ventilation Versus Pressure Support Ventilation. Anesth Analg 2009;109:

PHYSIOLOGIC GAS EXCHANGE VARIABLES*

	Equal Airway Pressure Limits†				Equal Minute Ventilation†			
	Baseline‡	PSV†	APRV† without Spontaneous Breathing	APRV† with Spontaneous Breathing	Baseline‡	PSV†	APRV† without Spontaneous Breathing	APRV† with Spontanepous Breathing
D_{O_2}	0.58 ± 0.02	0.58 ± 0.02	0.58 ± 0.02	0.58 ± 0.02	0.59 ± 0.02	0.59 ± 0.02	0.59 ± 0.02	0.59 ± 0.02
$P\bar{v}_{O_2}$, mm Hg	83 ± 3	86 ± 4	82 ± 4	102 ± 4§‖	82 ± 4	91 ± 4	84 ± 3§	104 ± 4§‖
pHa, units	7.34 ± 0.01	7.35 ± 0.02	7.34 ± 0.01	7.35 ± 0.02	7.34 ± 0.01	7.35 ± 0.02	7.35 ± 0.01	7.35 ± 0.01
Pa_{O_2}, mm Hg	42 ± 1	43 ± 2	41 ± 1	45 ± 1‖	42 ± 2	44 ± 2	42 ± 2§	45 ± 2‖
Hb, g · dl^{-1}	10.2 ± 0.3	10.1 ± 0.2	10.2 ± 0.3	10.2 ± 0.2	10.1 ± 0.1	10.1 ± 0.2	10.2 ± 0.3	10.1 ± 0.2
$\dot{V}o_2$, ml · kg · min^{-1} · m^{-2}	665 ± 34	684 ± 26	683 ± 30	782 ± 28§‖	673 ± 32	700 ± 27	626 ± 28§	753 ± 23§‖
Do_2, ml · min^{-1} · m^{-2}	155 ± 7	176 ± 7	157 ± 5§	163 ± 6	159 ± 7	173 ± 7	160 ± 6§	163 ± 6
ERR, %	24 ± 1	23 ± 1	23 ± 1	21 ± 1§‖	23 ± 1	22 ± 1	24 ± 1	22 ± 1‖

Definition of abbreviations: APRV = airway pressure release ventilation; Do_2 = oxygen delivery Fi_{O_2} = inspiratory fraction of oxygen; Hb = hemoglobin; Pa_{O_2} = arterial oxygen tension; PSV = pressure support ventilation; $P\bar{v}_{O_2}$ = mixed venous oxygen tension; $\dot{V}o_2$ = oxygen consumption.

* Values are mean ± SE.

† Tested on a randomized basis.

‡ At inclusion to the study; not used for statistical comparison.

LES CYCLES SPONTANÉS AMÉLIORENT LE RAPPORT P/F ET RÉDUISENT LE COEFFICIENT D'EXTRACTION D'OXYGÈNE

24 patients en SDRA ventilé en PSV, APRV, et BiLevel (APRV+SB). 12 avec même Pmax limite, 12 avec même Vmin.

N PUTENSEN, NORBERT J. MUTZ, GABRIELE PUTENSEN-HIMMER, and JÖRG ZINSERLING. Spontaneous Breathing During Ventilatory Support Improves Ventilation–Perfusion Di
in Patients with Acute Respiratory Distress Syndrome. AM J RESPIR CRIT CARE MED 1999;159:1

TABLE 5

INERT GAS EXCHANGE VARIABLES*

	Equal Airway Pressure Limits†				Equal Minute Ventilation†			
	Baseline‡	PSV†	APRV† without Spontaneous Breathing	APRV† with Spontaneous Breathing	Baseline‡	PSV†	APRV† without Spontaneous Breathing	APRV† with Spontaneous Breathing
RSS	2.97 ± 0.87	3.31 ± 0.96	2.81 ± 0.90	3.11 ± 0.94	3.17 ± 0.95	3.21 ± 1.10	2.99 ± 0.90	3.21 ± 1.05
Shunt, $\%\dot{Q}_T$	32 ± 3	29 ± 4	33 ± 4	24 ± 3‖§	33 ± 3	28 ± 4	32 ± 4	25 ± 3‖
Low $\dot{V}_A/\dot{Q}$, $\%\dot{Q}_T$	6 ± 2	8 ± 3	5 ± 3	6 ± 3	4 ± 2	8 ± 3	5 ± 3	6 ± 3
Normal $\dot{V}_A/\dot{Q}$, $\%\dot{Q}_T$	62 ± 6	63 ± 5	62 ± 6	70 ± 5‖§	63 ± 5	63 ± 6	62 ± 4	70 ± 5‖
High $\dot{V}_A/\dot{Q}$, $\%\dot{V}_E$	6 ± 4	10 ± 6	10 ± 6	10 ± 6	6 ± 4	10 ± 6	10 ± 6	10 ± 6
Dead space, $\%\dot{V}_E$	45 ± 6	41 ± 7	44 ± 9	38 ± 6‖§	45 ± 6	41 ± 7	44 ± 9	38 ± 6‖
$\overline{Q}$	0.89 ± 0.16	0.88 ± 0.17	0.90 ± 0.13	0.96 ± 0.18	0.94 ± 0.20	0.93 ± 0.21	0.96 ± 0.16	0.98 ± 0.21
$\log SD_Q$	0.92 ± 0.11	0.81 ± 0.13	0.89 ± 0.12	0.72 ± 0.10‖§	0.88 ± 0.15	0.91 ± 0.22	0.94 ± 0.19	0.78 ± 0.22‖§
$\overline{V}$	1.73 ± 0.26	1.58 ± 0.30	1.59 ± 0.34	1.56 ± 0.37	1.72 ± 0.33	1.58 ± 0.37	1.60 ± 0.41	1.55 ± 0.27
$\log SD_V$	0.95 ± 0.17	0.85 ± 0.21	0.96 ± 0.23	0.78 ± 0.22‖§	0.95 ± 0.17	0.88 ± 0.21	0.92 ± 0.23	0.79 ± 0.20‖§

Definition of abbreviations: APRV = airway pressure release ventilation; dead space = $\dot{V}_A/\dot{Q} > 100$; high $\dot{V}_A/\dot{Q} = 10 < \dot{V}_A/\dot{Q} < 100$; $\log SD_Q$ = log standard deviation of perfusion distribution; $\log SD_V$ = log standard deviation of ventilation; low $\dot{V}_A/\dot{Q} = 0.005 < \dot{V}_A/\dot{Q} < 0.1$; normal $\dot{V}_A/\dot{Q} = 0.1 < \dot{V}_A/\dot{Q} < 10$; PSV = pressure support ventilation; $\overline{Q}$ = mean $\dot{V}_A/\dot{Q}$ of blood flow; $\dot{Q}_T$ = pulmonary blood flow; RSS = residual sum of squares; shunt = $\dot{V}_A/\dot{Q} < 0.005$; $\overline{V}$ = mean $\dot{V}_A/\dot{Q}$ of ventilation; $\dot{V}_A/\dot{Q}$ = ventilation-perfusion ratio.

* Values are mean ± SE.

† Tested on a randomized basis.

‡ At inclusion to the study; not used for statistical comparison.

§ $p \leq 0.05$ compared with PSV.

‖ $p \leq 0.05$ compared with APRV without spontaneous breathing.

LE BILEVEL AMÉLIORE LE RAPPORT VENTILATION/PERFUSION

24 patients en SDRA ventilé en PSV, APRV, et BiLevel (APRV+SB). 12 avec même Pmax limite, 12 avec même Vmin.

N PUTENSEN, NORBERT J. MUTZ, GABRIELE PUTENSEN-HIMMER, and JÖRG ZINSERLING. Spontaneous Breathing During Ventilatory Support Improves Ventilation–Perfusion Di
in Patients with Acute Respiratory Distress Syndrome. AM J RESPIR CRIT CARE MED 1999;159:1

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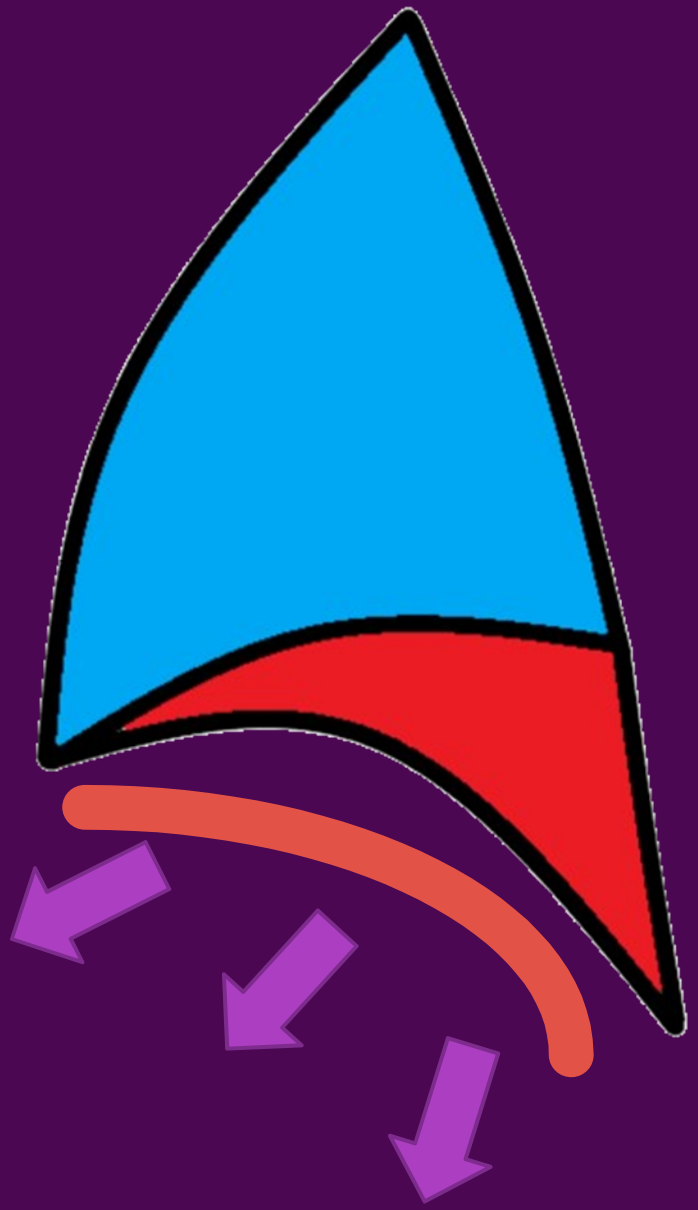

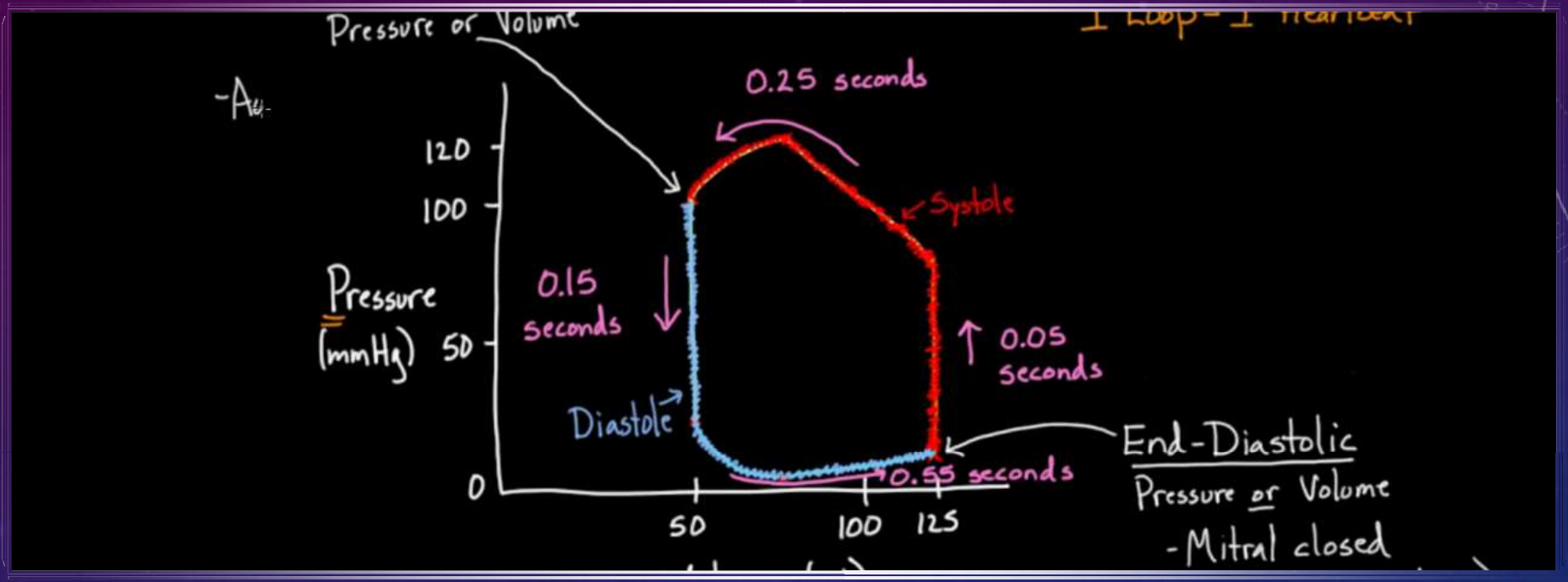

LES EFFETS HÉMODYNAMIQUES DU BILEVEL

LE BILEVEL AMÉLIORE LA FRACTION D'ÉJECTION DU VD ET L'IC

24 patients en SDRA ventilé en PSV, APRV, et BiLevel (APRV+SB). 12 avec même Pmax limite, 12 avec même Vmin.

TABLE 3

HEMODYNAMIC VARIABLES*

		Equal Airway Pressure Limits†				
	Baseline‡	PSV†	APRV† without Spontaneous Breathing	APRV† with Spontaneous Breathing	Baseline	PSV†
HR, min^{-1}	112 ± 5	112 ± 4	113 ± 4	106 ± 4	112 ± 5	106 ±
Psa, mm Hg	88 ± 3	91 ± 3	90 ± 2	94 ± 3	88 ± 3	89 ±
Ppa_{tm}, mm Hg	32 ± 2	31 ± 2	33 ± 1	29 ± 2§‖	32 ± 2	30 ±
Pcv_{tm}, mm Hg	16 ± 1	16 ± 1	15 ± 1	16 ± 1	16 ± 1	16 ±
Pao_{tm}, mm Hg	16 ± 1	16 ± 1	17 ± 1	16 ± 1	16 ± 1	16 ±
CI, $L \cdot min^{-1} \cdot m^{-2}$	5.1 ± 0.2	5.3 ± 0.2	5.0 ± 0.2§	5.6 ± 0.2§‖	5.1 ± 0.2	5.1 ±
SVR, $dyn \cdot s \cdot cm^{-5}$	550 ± 25	550 ± 25	565 ± 31	521 ± 24	550 ± 25	535 ±
PVR, $dyn \cdot s \cdot cm^{-5}$	126 ± 12	115 ± 15	130 ± 19	95 ± 17§‖	127 ± 14	112 ±
RVEF, %	33 ± 2	36 ± 1	32 ± 2§	41 ± 2§‖	34 ± 2	38 ±
RVEDVI, $ml \cdot m^{-2}$	122 ± 3	128 ± 4	123 ± 5§	136 ± 4§‖	122 ± 3	126 ±
RVESVI, $ml \cdot m^{-2}$	86 ± 7	82 ± 2	87 ± 3	82 ± 2	82 ± 7	78 ±

Definition of abbreviations: APRV = airway pressure release ventilation; CI = cardiac index; HR = heart
monary artery occlusion pressure; Pcv_{tm} = transmural mean central venous pressure; Ppa_{tm} = transmura
Psa = mean systemic arterial pressure; PSV = pressure support ventilation; PVR = pulmonary vascular re

N PUTENSEN, NORBERT J. MUTZ, GABRIELE PUTENSEN-HIMMER, and JÖRG ZINSERLING. Spontaneous Breathing During Ventilatory Support Improves Ventilation–Perfusion Di
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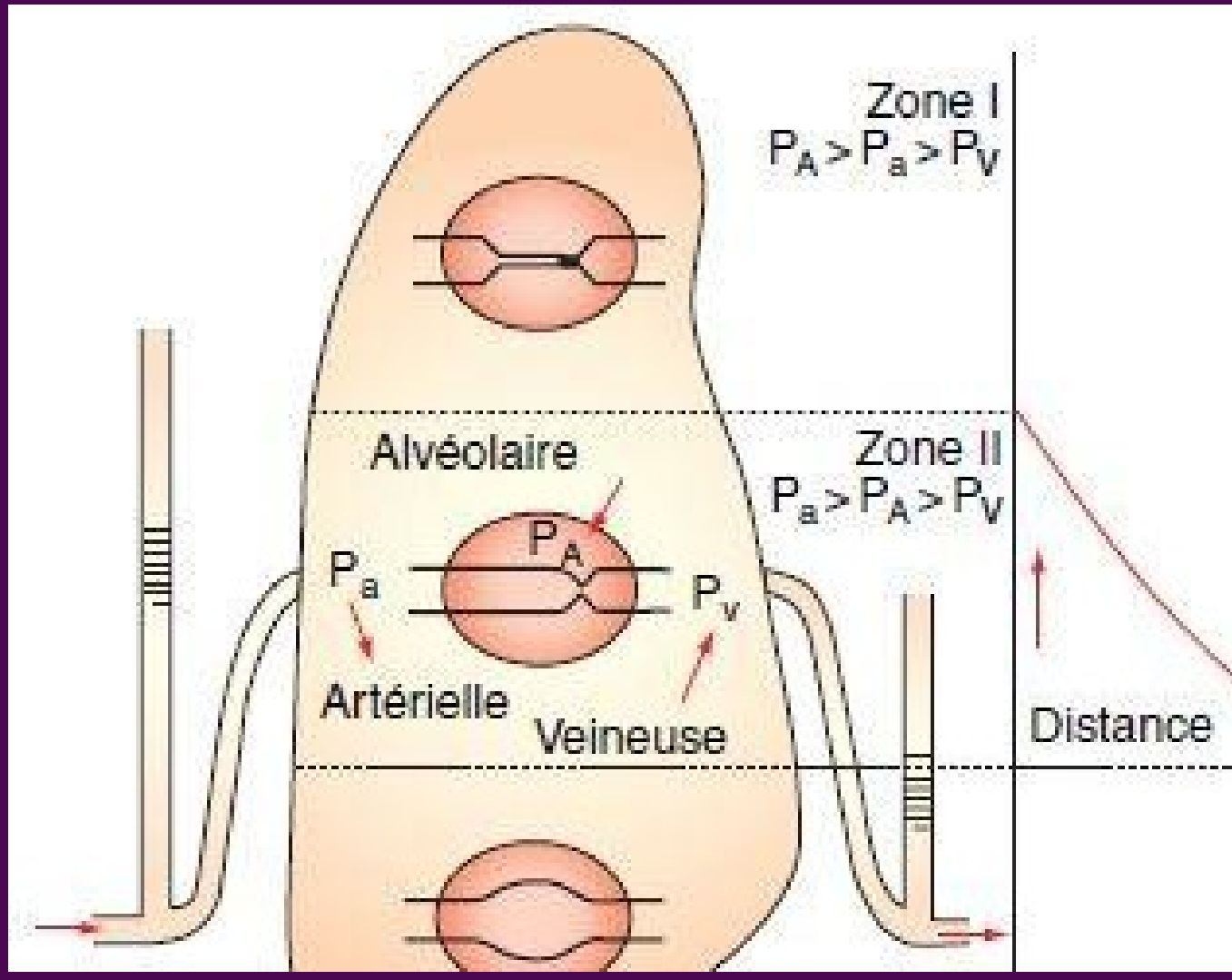
EFFETS HÉMODYNAMIQUES



LE BILEVEL AMÉLIORE LE DÉBIT CARDIAQUE ET LA PERFUSION TISSULAIRE

12 patients en SDRA ont été « switchés » de VPC protectrice avec curarisation au mode BiLevel.

Table 1

Data for selected parameters while patients were v with PCV-IRV or APRV

Parameter	PCV-IRV	APR
P_{awpk} (cmH_2O)	38 ± 3	25 ±
P_{awmean} (cmH_2O)	18 ± 3	12 ±
Paralytics (% of patients)	74	4
Sedative use (% of PCV patients)	100	68
Pressors (% of patients)	92	45
Lactate (mmol/l)	2.2 ± 0.4	1.8 ±
Cardiac index (l/min/m^2)	3.2 ± 0.4	4.6 ±
DO_2 (ml/min)	997 ± 108	1409 ±

s J Kaplan, Heatherlee Bailey, Vincent Formosa. Airway pressure release ventilation increases cardiac performance in patients with acute lung injury/adult respiratory distress
Critical Care 2001, 5

POUR RÉSUMER, LE MODE BILEVEL AU COURS DU SDRA PERMET :

- Une amélioration du rapport Ventilation / Perfusion
- Une réduction des atélectasies
- Une amélioration du rapport PaO2/FiO2
- Une baisse du coefficient d'extraction d'Oxygène
- Une réduction des résistances vasculaires pulmonaires
- Une amélioration de la fraction d'éjection du VD
- Une amélioration du débit cardiaque
- Une amélioration de la perfusion tissulaire

BIPAP VERSUS PS IN SPONTANEOUS VENTILATION

- Significant reduction in the shunts and dead space (respiratory and hemodynamic effects)
- Increase in the PaO2/FiO2

- Putensen C, Mutz NJ, Putensen-Himmer G, Zinserling J. Spontaneous breathing during ventilatory support improves ventilation—perfusion distributions in patients with acute respiratory distress syndrome. Am J Respir Crit Care Med 1999;159:1241—8.
- Putensen C, Zech S, Wrigge H, Zinserling J, Stuber F, Von Spiegel T, et al. Long-term effects of spontaneous breathing during ventilatory support in patients with acute lung injury. Am J Respir Crit Care Med 2001;164:43—9.
- Putensen C, Rasanen J, Lopez FA, Downs JB. Effect of interfacing between spontaneous breathing and mechanical cycles on the ventilation—perfusion distribution in canine lung injury. Anesthesiology 1994;81:921—30.
- Wrigge H, Zinserling J, Neumann P, Muders T, Magnusson A, Putensen C, et al. Spontaneous breathing with airway pressure release ventilation favors ventilation in dependent lung regions and counters cyclic alveolar collapse in oleic-acid-induced lung injury: A randomized controlled computed tomography trial. Crit Care 2005;9:780—9.
- Sydow M, Burchardi H, Ephraim E, Zielmann S, Crozier TA. Longterm effects of two different ventilatory modes on oxygenation in acute lung injury. Comparison of airway pressure release ventilation and volume-controlled inverse ratio ventilation. Am J Respir Crit Care Med 1994;149:1550—6.

BILEVEL VS VENTILATION PROTECTRICE CONVENTIONNELLE

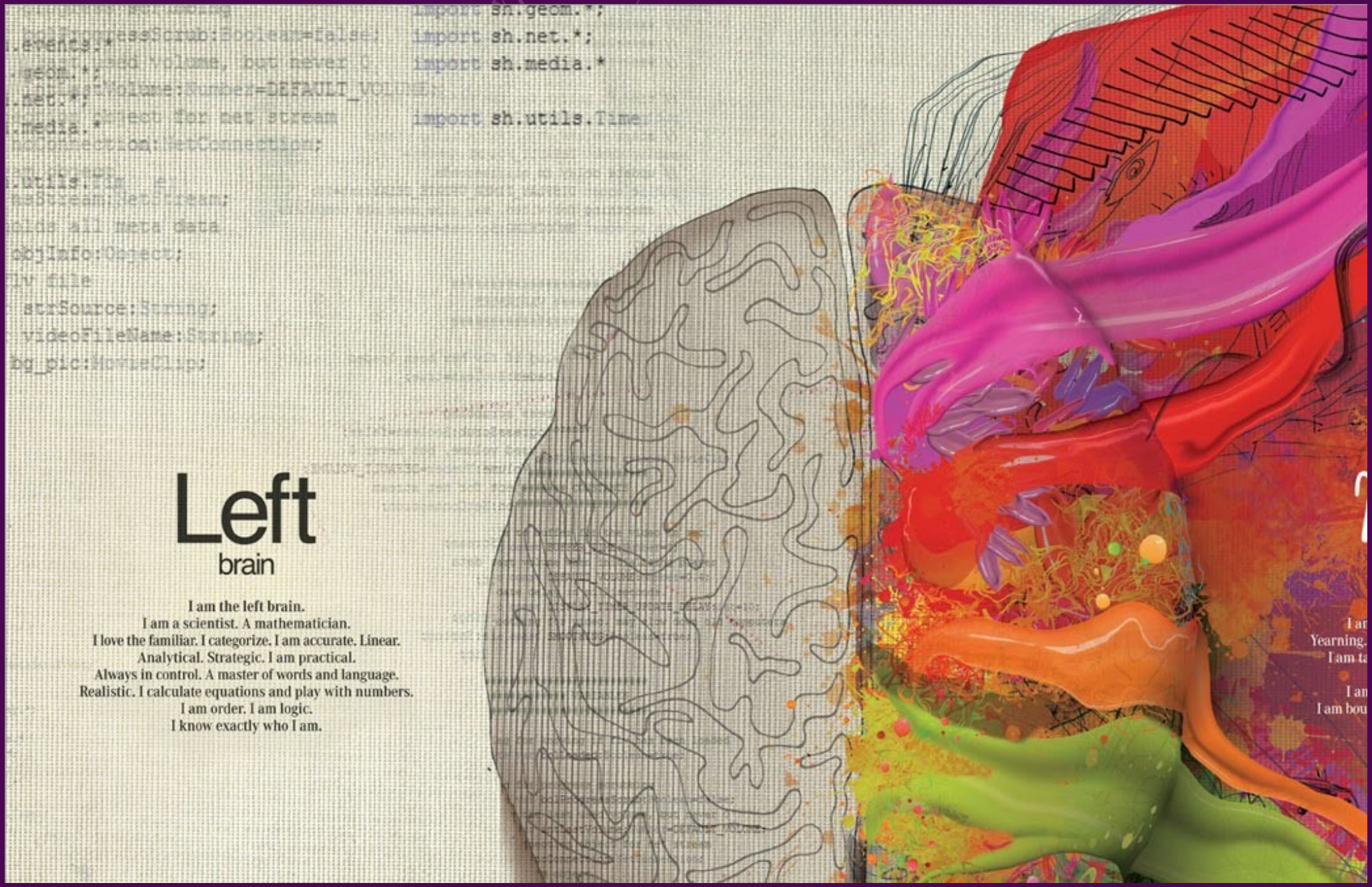

Left
brain
I am the left brain.
I am a scientist. A mathematician.
I love the familiar. I categorize. I am accurate. Linear.
Analytical. Strategic. I am practical.
Always in control. A master of words and language.
Realistic. I calculate equations and play with numbers.
I am order. I am logic.
I know exactly who I am.

Table I. The changes of gas exchange and pulmonary mechanics in ARDS.

Parameters	Baseline	After injury	1 h	2 h	4 h
P/F (mmHg)					
CMV	557±68	69±14	89±26	79±19	73±20
LTV+SI	563±51	74±24	199±35[a,b]	216±45[a,b]	239±50[a,b]
APRV	581±56	74±23	222±41[a,b]	322±53[a-c]	346±62[a-c]
$PaCO_2$ (mmHg)					
CMV	35±5	46±6	46±5	47±7[c]	47±6
LTV+SI	35±6	45±5	52±6	53±5[a]	57±7[a,b]
APRV	34±5	43±8	40±6[c]	39±6[c]	39±6[c]
MV (ml/min)					
CMV	3,956±235	4,150±187	4,132±175	4,168±175	4,216±229
LTV+SI	3,833±314	4,078±281	3,083±471[a,b]	3,167±408[a,b]	3,209±442[a,b]
APRV	4,024±210	4,135±261	4,334±427[c]	4,371±487[c]	4,438±476[c]
Cst (ml/cmH_2O)					
CMV	25±9	10±5	7±3	6±2	5±3
LTV+SI	24±10	8±6	5±2	5±1	4±2
APRV	26±8	8±7	7±3	8±2	7±3

LE BILEVEL VS VENTILATION PROTECTRICE CONVENTIONNELLE : AMÉLIORE LE P/F, LA PaCO2, LA COMPLIANCE PULMONAIRE

Modèle animal.

GUAN-JIE HAN, JIA-QIONG LI, CUI-GAI PAN et al. Experimental study of airway pressure release ventilation in the treatment of acute respiratory distress
Experimental and therapeutic medicine 14: 1941-1

iable	Baseline			Day 3 after enrollment [c,d]		
	APRV	LTV	*P* value	APRV	LTV	*P* value
PEEP (cmH_2O)	11.4 ± 3.0	10.4 ± 2.6	0.063	6.9 ± 1.8	10.4 ± 2.8	<0.001
FIO_2	0.66 ± 0.19	0.62 ± 0.19	0.198	0.43 ± 0.09	0.53 ± 0.19	0.001
Respiratory rate (cycles/min)	21.5 ± 6.6	19.5 ± 4.6	0.039	19.0 ± 6.0	20.3 ± 5.1	0.225
Peak inspiratory pressure (cmH_2O)	31.7 ± 4.5	30.4 ± 4.0	0.061	26.2 ± 3.6	28.5 ± 4.8	0.005
Mean airway pressure (cmH_2O)	18.3 ± 3.9	17.4 ± 3.5	0.140	21.8 ± 3.5	16.0 ± 3.3	<0.001
Plateau pressure (cmH_2O)	26.5 ± 4.0	25.3 ± 3.6	0.081	19.3 ± 3.9	23.3 ± 4.6	<0.001
Driving pressure (cmH_2O)[a]	15.2 ± 3.6	14.8 ± 3.4	0.550	12.6 ± 3.5	12.8 ± 4.1	0.822
Respiratory system compliance (mL/cmH_2O)	30.1 ± 7.6	32.6 ± 7.7	0.058	43.7 ± 11.3	34.1 ± 8.9	<0.001
Total minute ventilation (L/min)[b]	8.37 ± 2.36	8.42 ± 1.98	0.905	6.86 ± 2.06	8.22 ± 2.30	0.001
Spontaneous minute ventilation (L/min)	-	-		1.78 ± 1.37	-	
pH	7.37 ± 0.09	7.38 ± 0.10	0.427	7.42 ± 0.05	7.42 ± 0.07	0.648
$PaCO_2$ (mmHg)	40.1 ± 7.4	41.7 ± 10.5	0.307	40.8 ± 7.3	42.3 ± 8.6	0.291
PaO_2 (mmHg)	72.5 ± 13.1	76.8 ± 20.5	0.149	116.2 ± 28.5	84.8 ± 20.1	<0.001
PaO_2:FiO_2	121.7 ± 46.8	138.3 ± 56.1	0.060	280.3 ± 83.9	180.5 ± 68.6	<0.001

BILEVEL VS VP CONVENTIONNELLE : AMÉLIORE LA COMPLIANCE PULMONAIRE, RÉDUIT LA PRESSION DE PLATEAU, AMÉLIORE LE RAPPORT P/F

138 SDRA, 71 en BiLevel vs 67 en VP conventionnelle

Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

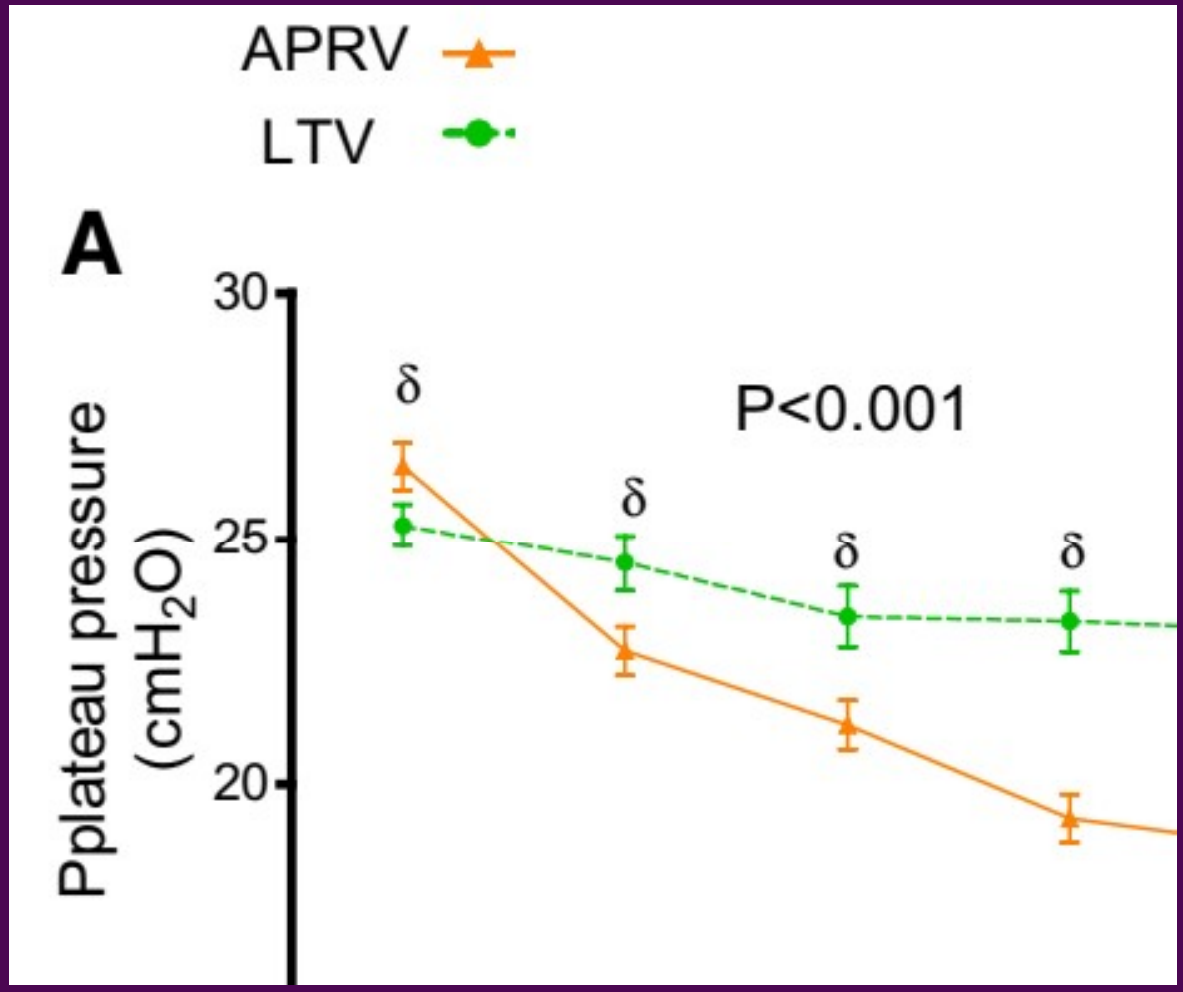
Variable	Baseline			Day 3 after enrollment [c,d]		
	APRV	LTV	*P* value	APRV	LTV	*P* value
Hemodynamic variables						
Heart rate (beats/min)	105.4 ± 22.5	110.2 ± 24.6	0.238	92.7 ± 16.6	103.6 ± 19.3	0.001
Systolic blood pressure (mmHg)	122.2 ± 17.9	116.2 ± 22.5	0.088	126.6 ± 18.0	125.0 ± 20.3	0.646
Diastolic blood pressure (mmHg)	72.8 ± 13.2	68.6 ± 12.1	0.053	76.1 ± 14.5	69.3 ± 13.3	0.009
Mean arterial pressure (mmHg)	87.4 ± 14.7	84.2 ± 13.4	0.194	92.8 ± 14.9	87.1 ± 13.6	0.032

LE BILEVEL AMÉLIORE L'HÉMODYNAMIQUE DES PATIENTS

138 SDRA, 71 en BiLevel vs 67 en VP conventionnelle

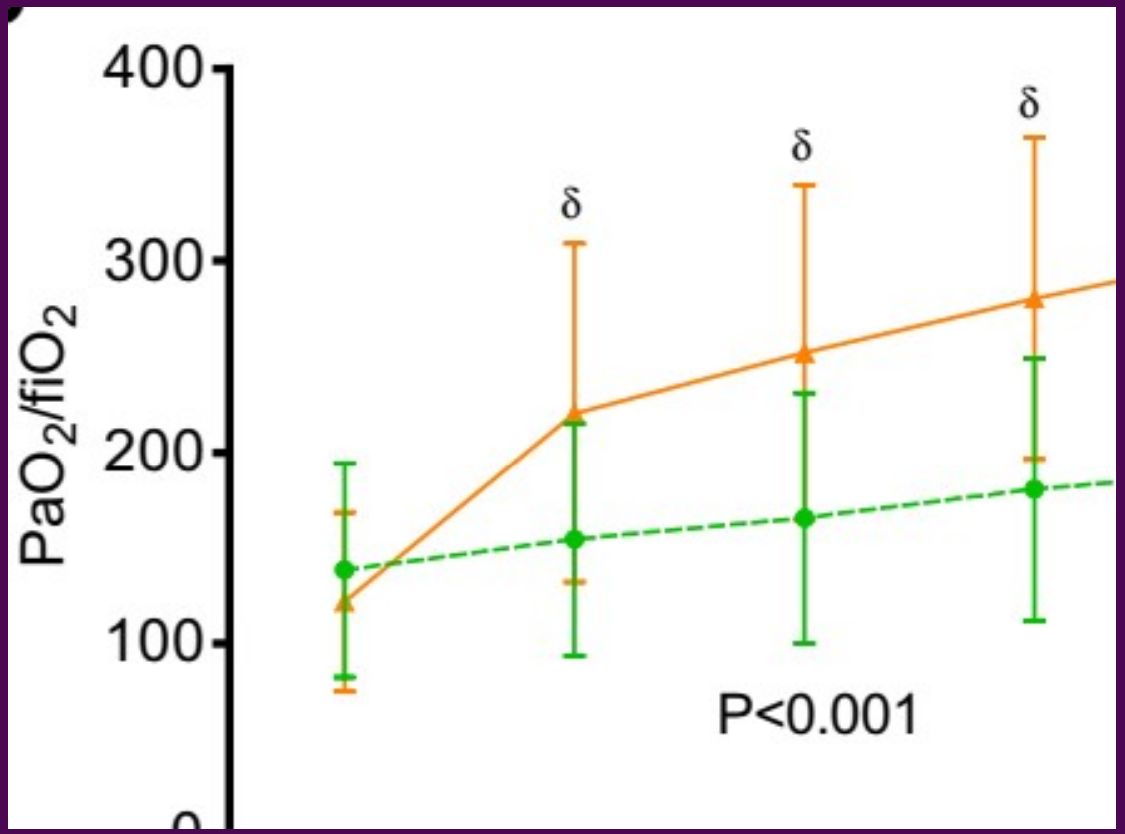
Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

MEILLEURE PRESSION DE PLATEAU



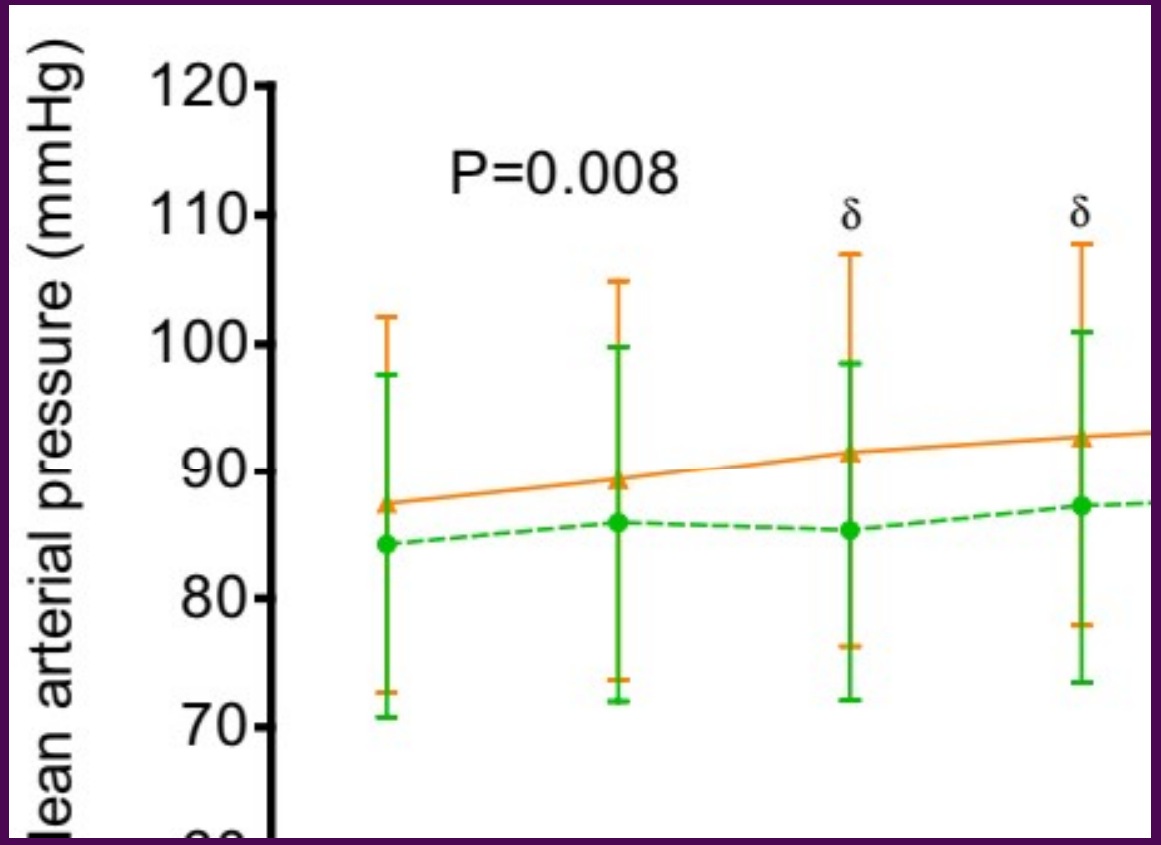
Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

MEILLEUR P/F



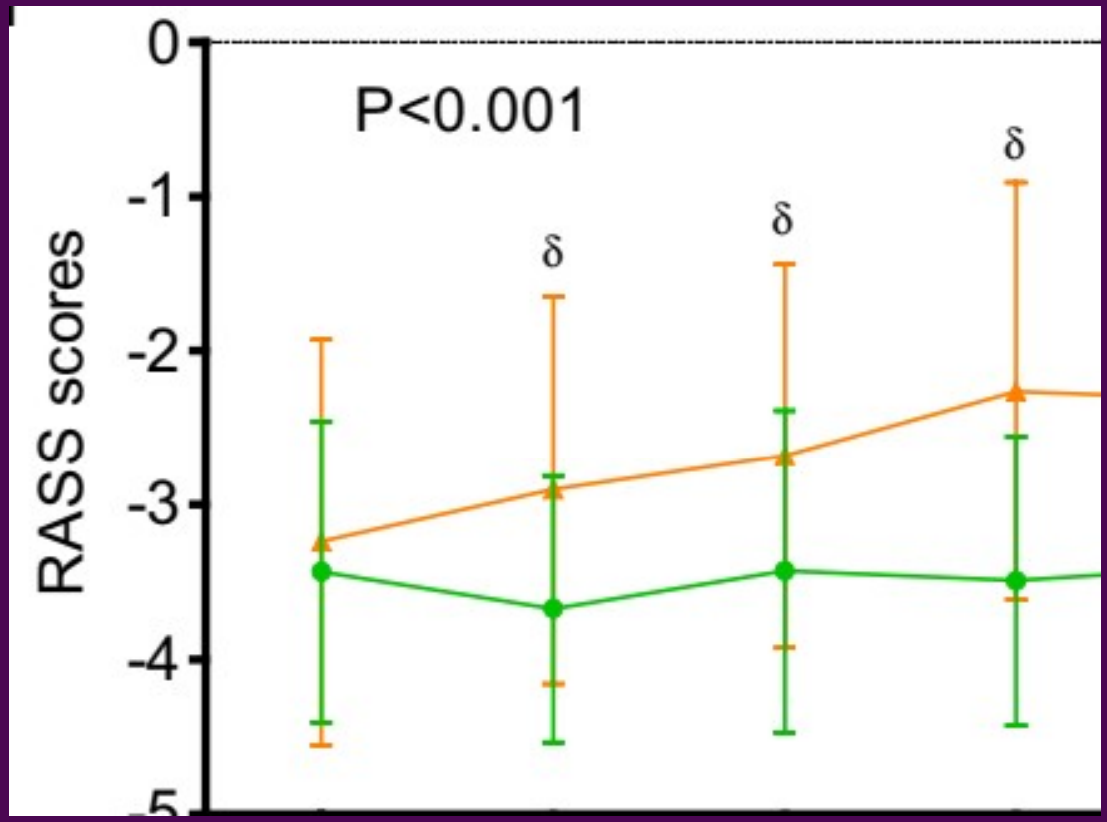
Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

MEILLEURE PAM



Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

MOINS DE SÉDATION



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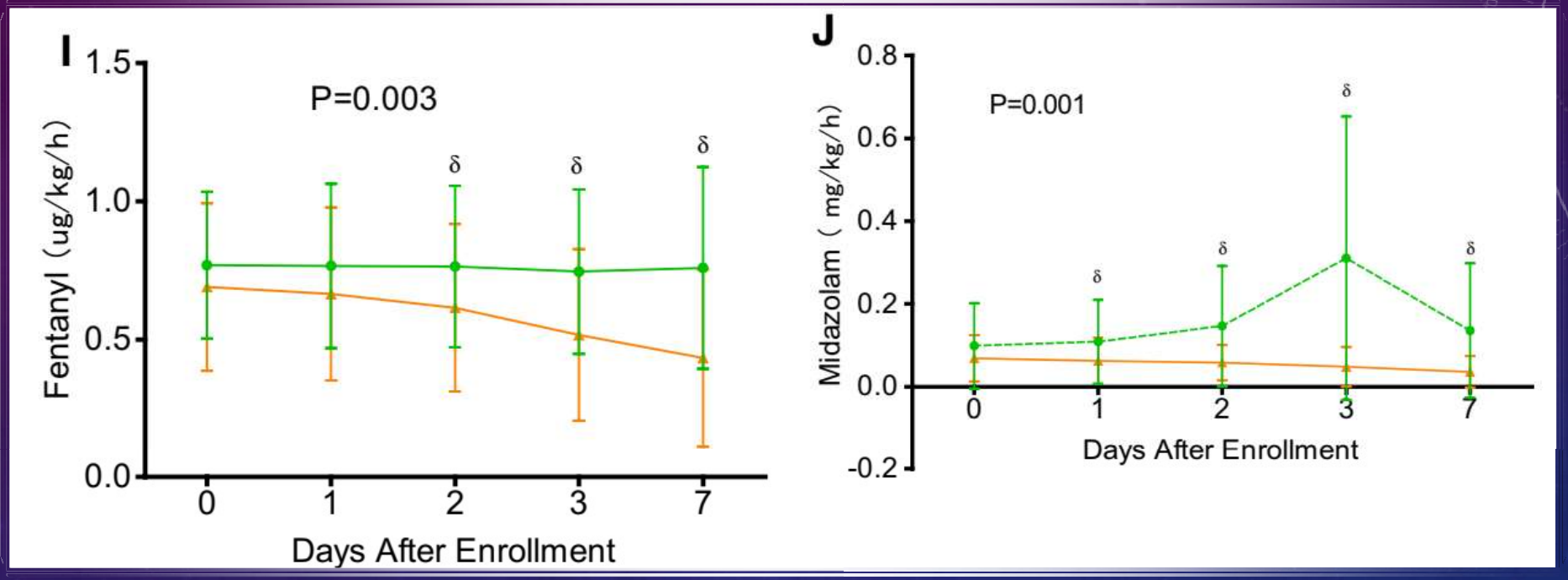
Intensive Care Med (2017) 43:1



MOINS DE SÉDATION

Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

LE BILEVEL :

- RÉDUIT LA DURÉE DE LA VENTILATION MÉCANIQUE
- AMÉLIORE LES CHANCES DE SEVRAGE
- RÉDUIT LE RECOURS A LA TRACHEO
- RÉDUIT LE SÉJOUR EN RÉA
- TENDANCE À LA RÉDUCTION DE LA MORTALITÉ HOSPITALIÈRE

138 SDRA, 71 en BiLevel vs 67 en VP conventionnelle

Table 3 Main outcome variables

Main outcome variables	APRV ($n = 71$) [b]	LTV ($n = 67$)
No. of days of ventilation	8 [5–14]	15 [7–2
No. of ventilator-free days at 28 days	19 [8–22]	2 [0–15]
Successful extubation	47 (66.2%)	26 (38.8
Tracheostomy	9 (12.7%)	20 (29.9
Length of ICU stay (days)	15 [8–21]	20 [10–3
Pneumothorax between day 1 and day 28[a]	3 (4.2%)	7 (10.4%
Death during the ICU stay	14 (19.7%)	23 (34.3
Length of hospital stay (days)	21 [14–30]	27 [18–4
Death during the hospital stay	17 (23.9%)	25 (37.3
Other supportive therapies		
Neuromuscular blocker	2 (2.8%)	9 (13.4%
Recruitment maneuvers	4 (5.6%)	11 (16.4

Yongfang Zhou, Xiaodong Jin, Yinxia Lv. Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress
Intensive Care Med (2017) 43:1

DON’T MAKE HALF CHOICES. DO IT !

- L’initiation du BiLevel dès le début de la prise en charge de patients à risque de SDRA :
  - Réduit le risque de survenue de SDRA
  - Réduit la durée de la VM
  - Réduit la durée de séjour en Réa

Putensen C, Zech S, Wrigge H, Zinserling J, Stuber F, Von Spiegel T, et al. Long-term effects of spontaneous breathing during ventilatory support in patients with acute lung injury. Am J Respir Crit Care Med 2001;164:43—9.

LE BILEVEL LORSQU'IL EST UTILISÉ INITIALEMENT CHEZ DES PATIENTS À RISQUE RÉDUIT SIGNIFICATIVEMENT LA SURVENUE DE SDRA

Les auteurs voulaient avoir si l'utilisation du BiLevel à a place du VPC dès l'intubation de patients polytraumatisés pouvait réduire le risque de survenue de SDRA

15 BiLevel vs 15 VPC

TABLE 2. OUTCOME DATA*

	APRV Group	PCV G
Number of patients, n (%)	15 (100)	15 (
Survivors, n (%)	12 (80)	11 (
ARDS, n (%)	3 (20)	11 (
ALI non ARDS, n (%)	8 (53)	4 (
Extrapulmonary organ failure, n (%)†		
1	8 (53)	10 (
2	6 (38)	7 (
⩾ 3	1 (9)	0 (
Sepsis, n (%)	9 (75)	10 (
Length of ventilatory support, d	15 ± 2	21
Length of intubation, d	18 ± 2	25
Length of ICU stay, d	23 ± 2	30

Putensen C, Zech S, Wrigge H, Zinserling J, Stuber F, Von Spiegel T, et al. Long-term effects of spontaneous breathing during ventilatory support in patients with acute l
Am J Respir Crit Care Med 2001;1

LES LIMITES DU BILEVEL

EST-CE RÉELLEMENT UNE LIMITE ?

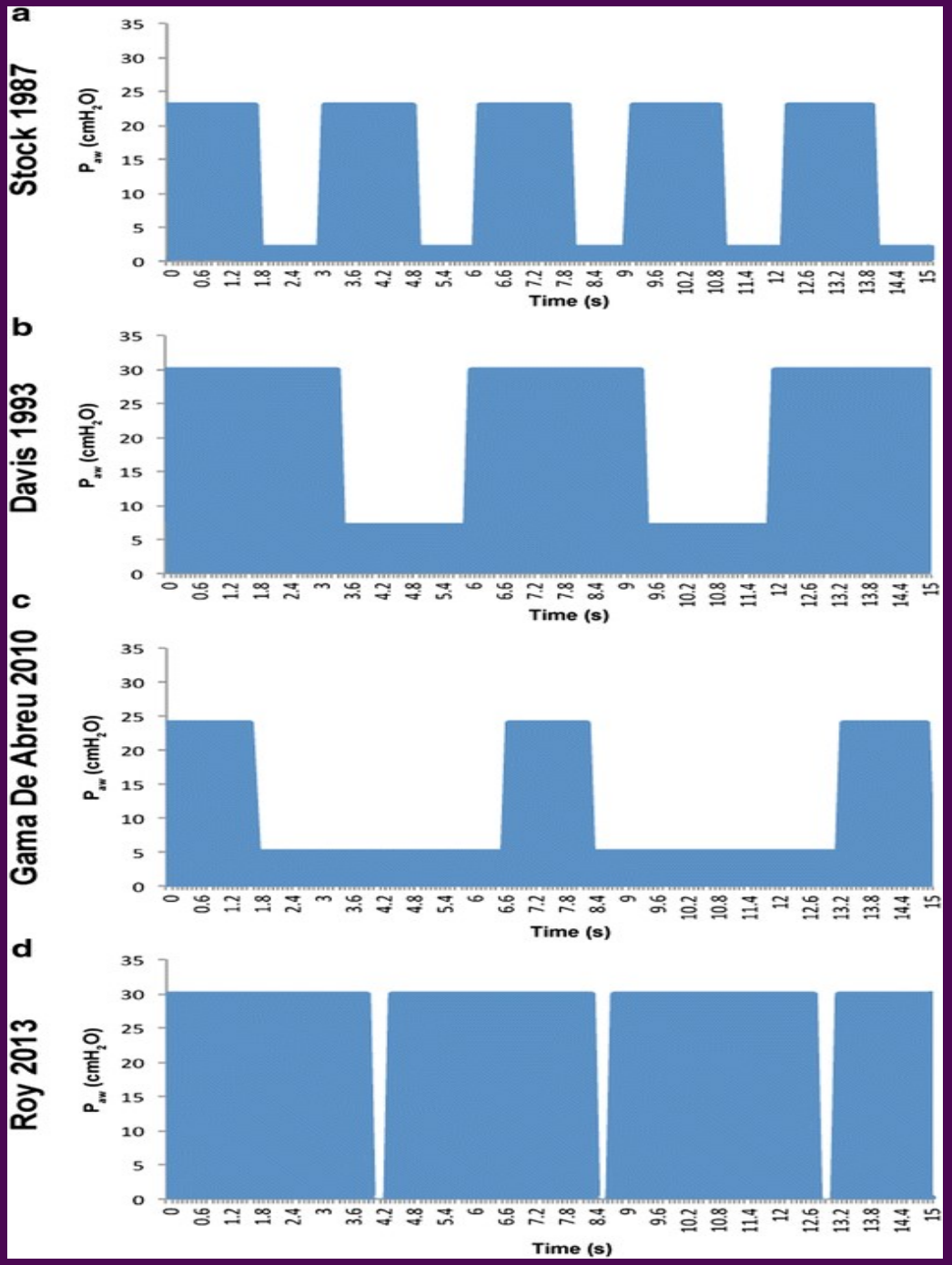
- La ventilation minute et le Vt variant instantanément en fonction des variations de la compliance pulmonaire…
- Manque d'étude sur l'optimisation des paramètres ventilatoires…
- Risque d'asynchronie

LA LIMITANTE PRINCIPALE DU BILEVEL

C’est peut être l’anxiété du médecin…

BILEVEL ???

Tous ces auteurs bien que ne testant pas réellement le mode BiLevel (APRV+SB), et n'utilisent pas les mêmes paramètres ventilatoires, disent tous la même chose, c'est de l'APRV.



TAKE HOME MESSAGES

- Ventilating the “spontaneous lung”
- Homogenizing the Ventilation / Perfusion
- Increasing the PaO2/FiO2
- Improving hemodynamics and tissue perfusion
- Decreasing the risk of diaphragm atrophy
- Decreasing the use of sedation and curarization
- Decreasing the total time of ventilation
- Decreasing the length of stay in the intensive care units
- More successful weaning
- Improving survival in ARDS

THANK YOU