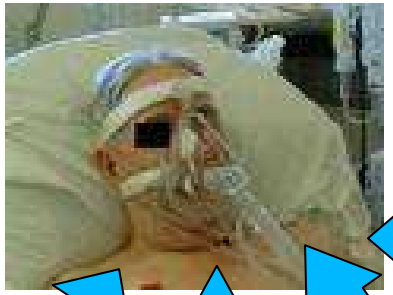
CPAP en pré-hospitalier et aux urgences

4ème Journée de Réanimation et Urgences Respiratoires

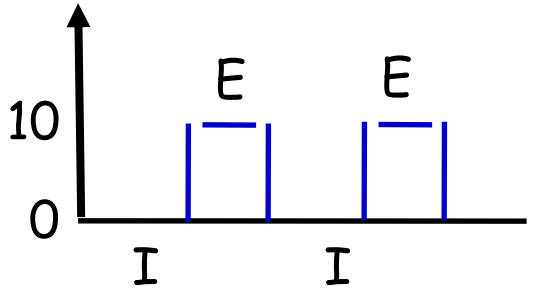
Ventilation Non Invasive (VNI)
Définition

- Ventilation sans intubation trachéale.
- Par l’intermédiaire d’un masque
- Ventilation spontanée conservée (VS)

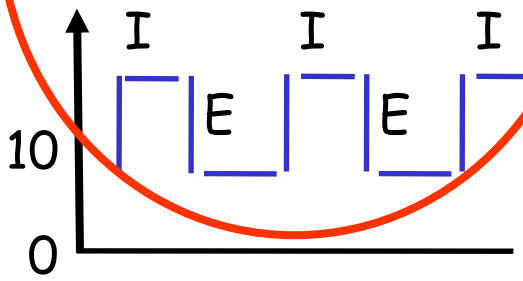
Sous quelle forme la pression peut-elle être administrée au patient ?



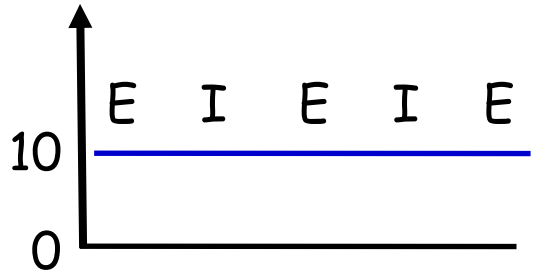
PEP : pression expiratoire positive



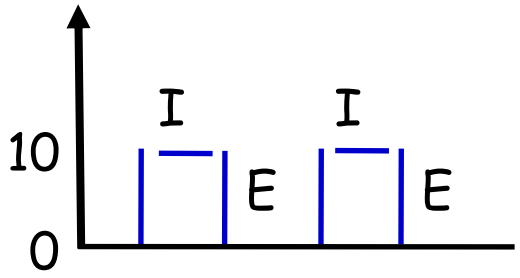
VS-AI-PEP :
Aide insp. +/- PEP



CPAP : « continuous positive airway pressure"

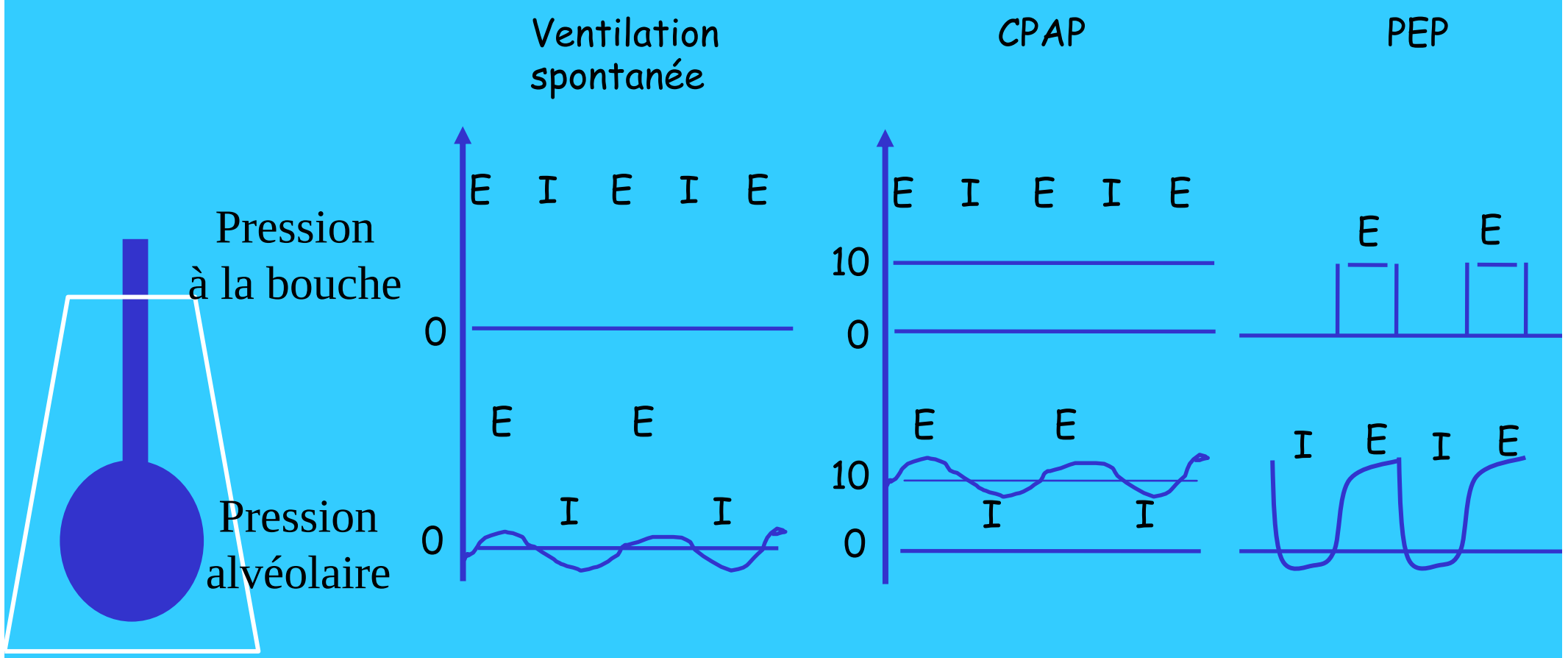


AI : aide inspiratoire



VNI = VS-AI-PEP ou CPAP

Différence entre CPAP et ventilation spontanée avec PEP



⚠ **CPAP aussi appelée VS-PEP**

Ventilation Non Invasive

Conférence de consensus commune SFAR, SPLF, SRLF.

Oct. 2006

- BPCO décompensée :
  - intérêt de la **VS-AI-PEP** (G1+)
  - pas d'intérêt de la CPAP
- Oedème aigu du poumon (OAP) :
  - intérêt de la **CPAP** ou de la **VS-AI-PEP** (G1+)
  - intérêt certain si détresse majeure avec hypercapnie (G1+)
  - intérêt probable, même si non démontré, dès que détresse respiratoire (G2+)
  - en cas de non réponse au traitement médical

Ventilation Non Invasive

Conférence de consensus commune SFAR, SPLF, SRLF.

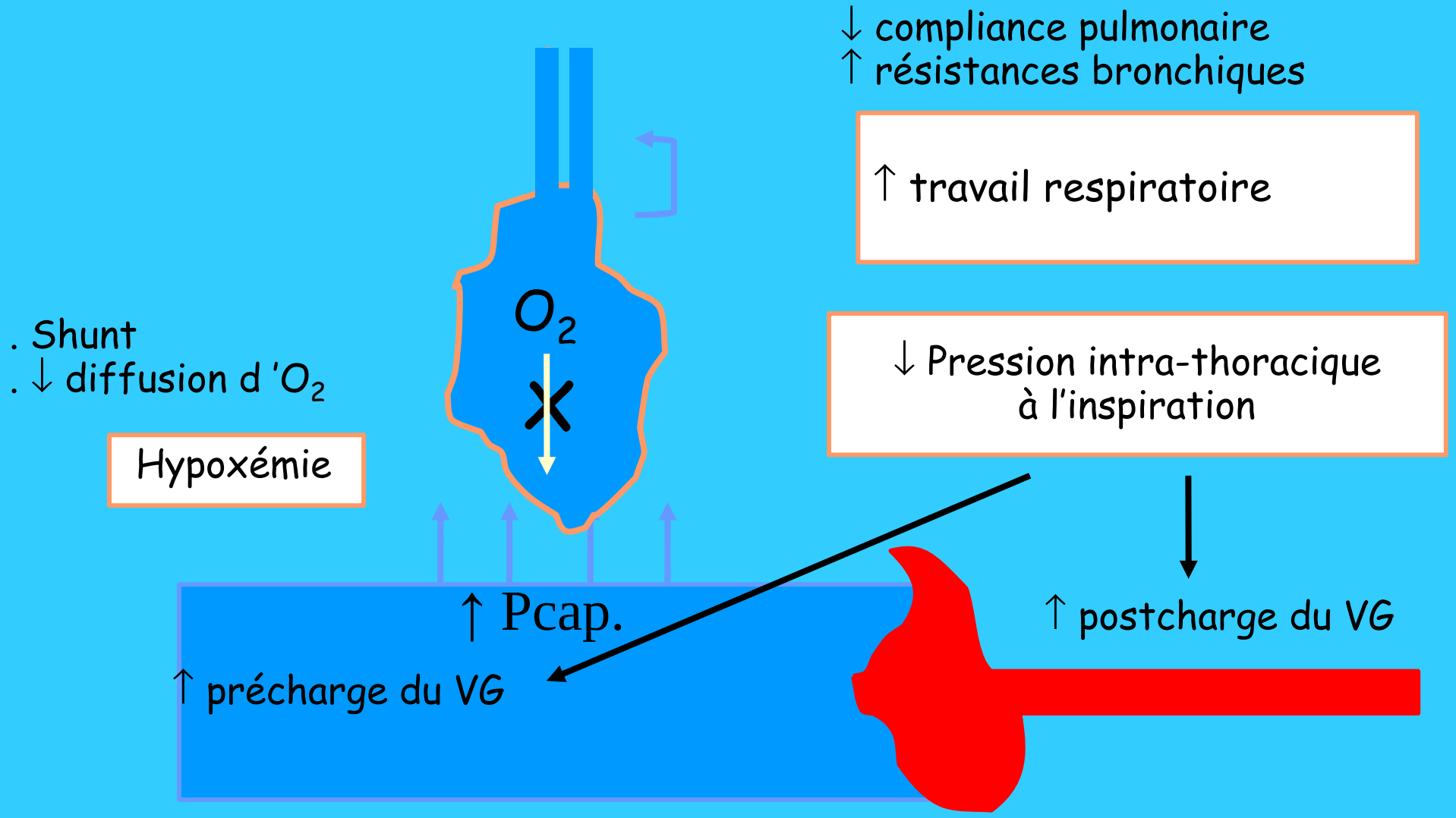
Oct. 2006

- En pré-hospitalier ou aux urgences :
  - La VNI se limite à la CPAP sur l'OAP (G1+)
  - VS-AI-PEP :
    - pour OAP ou BPCO,
    - uniquement si équipe entraînée et équipée de respirateurs adaptés (G2+)

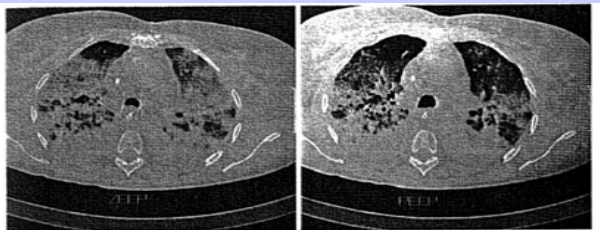
Plan

- CPAP et OAP :
  - Physiopathologie de l'OAP
  - Effets de la pression positive sur l'OAP
  - En pratique : quelle CPAP et comment ?
  - Contre-indications à la CPAP ?
  - CPAP versus VS-AI-PEP
- Autres indications de la VNI en préhospitalier ?

Physiopathologie de l'OAP

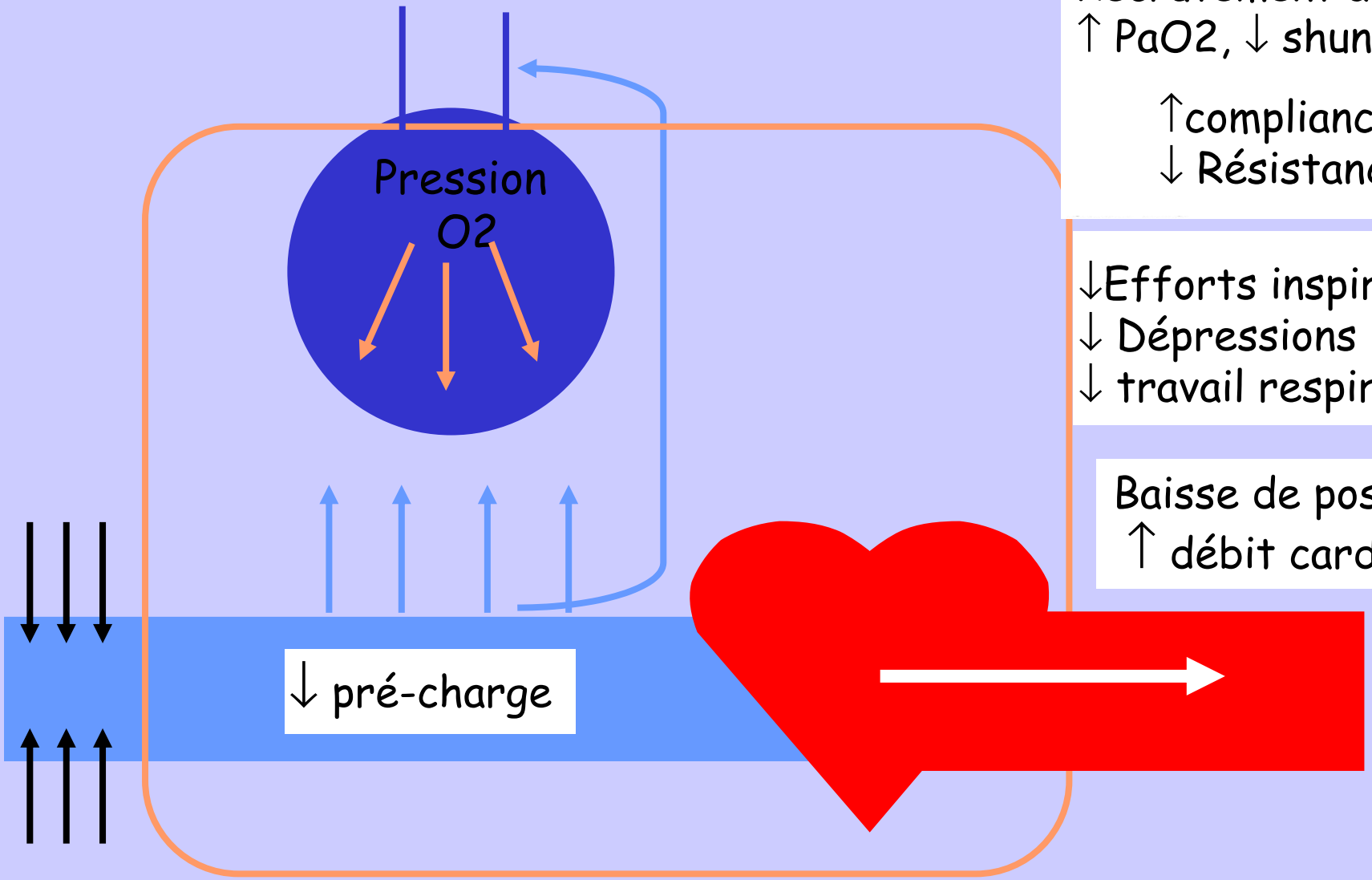


Mécanismes d'action de la CPAP



Recrutement alvéoles,
↑ PaO2, ↓ shunt,

↑compliance
↓ Résistances

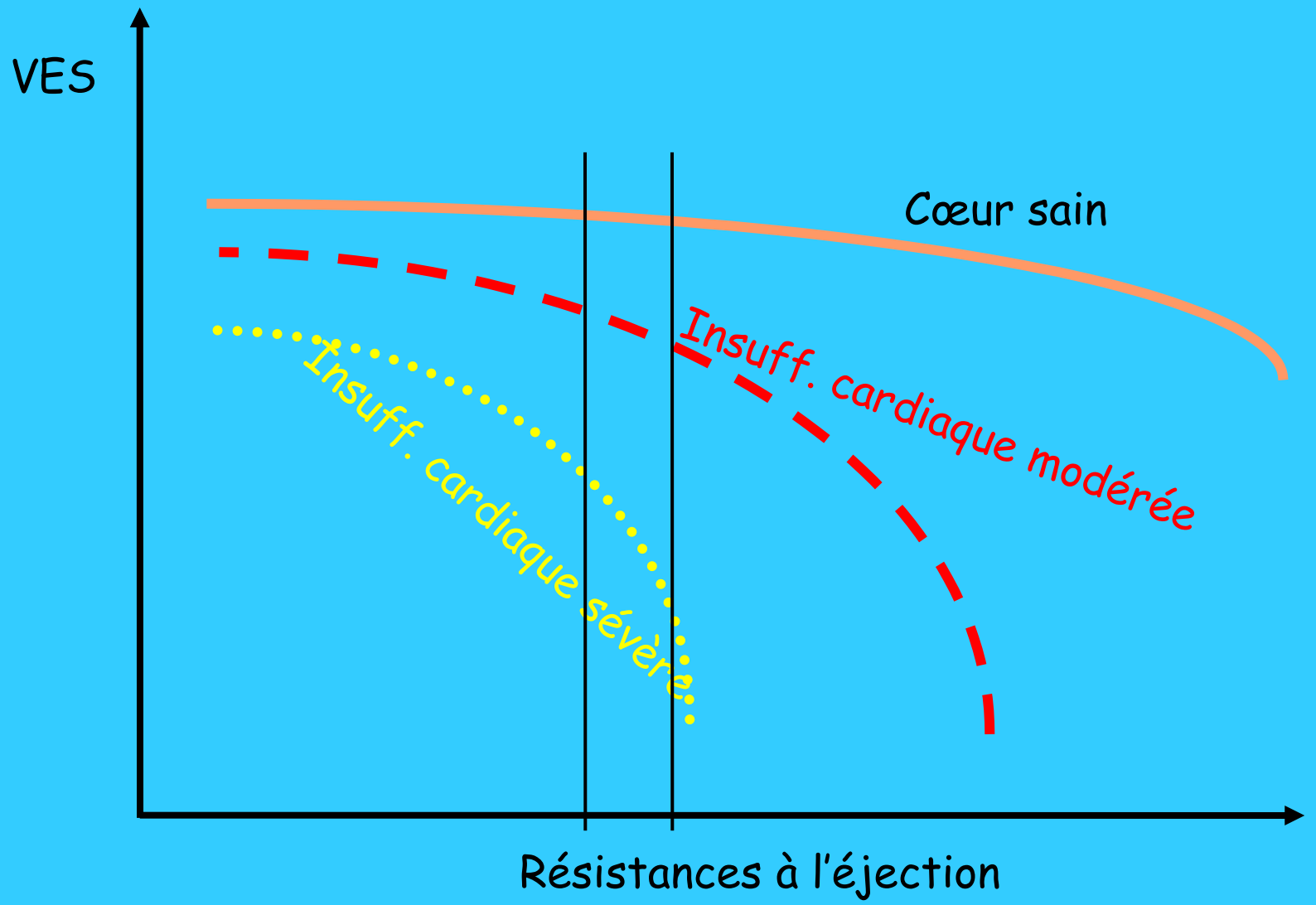


↓Efforts inspiratoires
↓ Dépressions intra-thorax
↓ travail respiratoire

Baisse de post-charge
↑ débit cardiaque

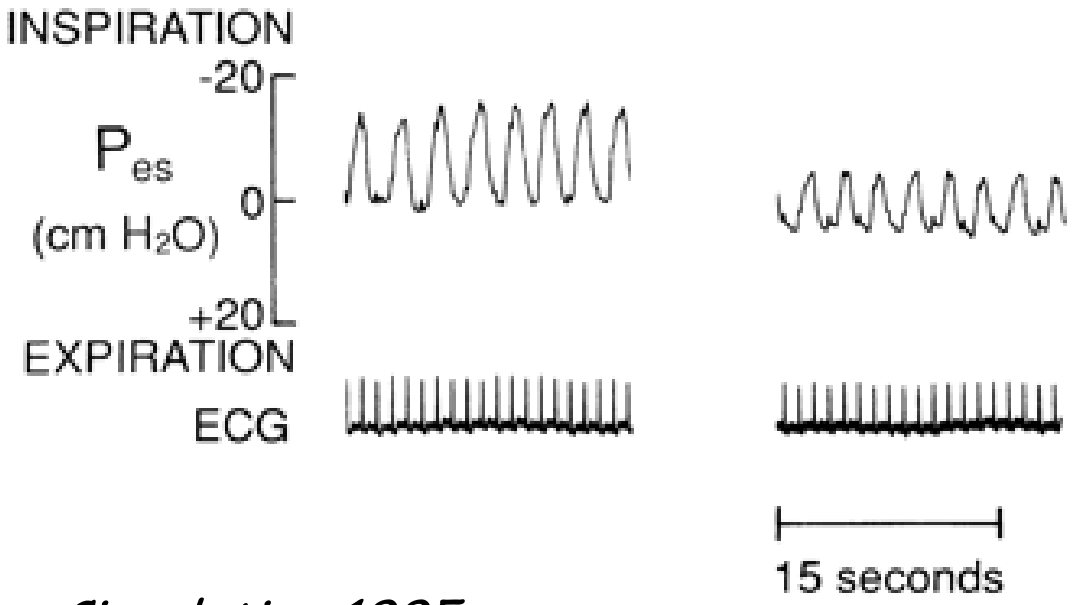
Relation RAS/VES : Influence de la postcharge

Cohn J, NEJM 1977



Effets de la pression positive sur l'OAP :
diminution des efforts inspiratoires
disparition des dépressions intra-thoraciques

VS CPAP 10 cm H_2O

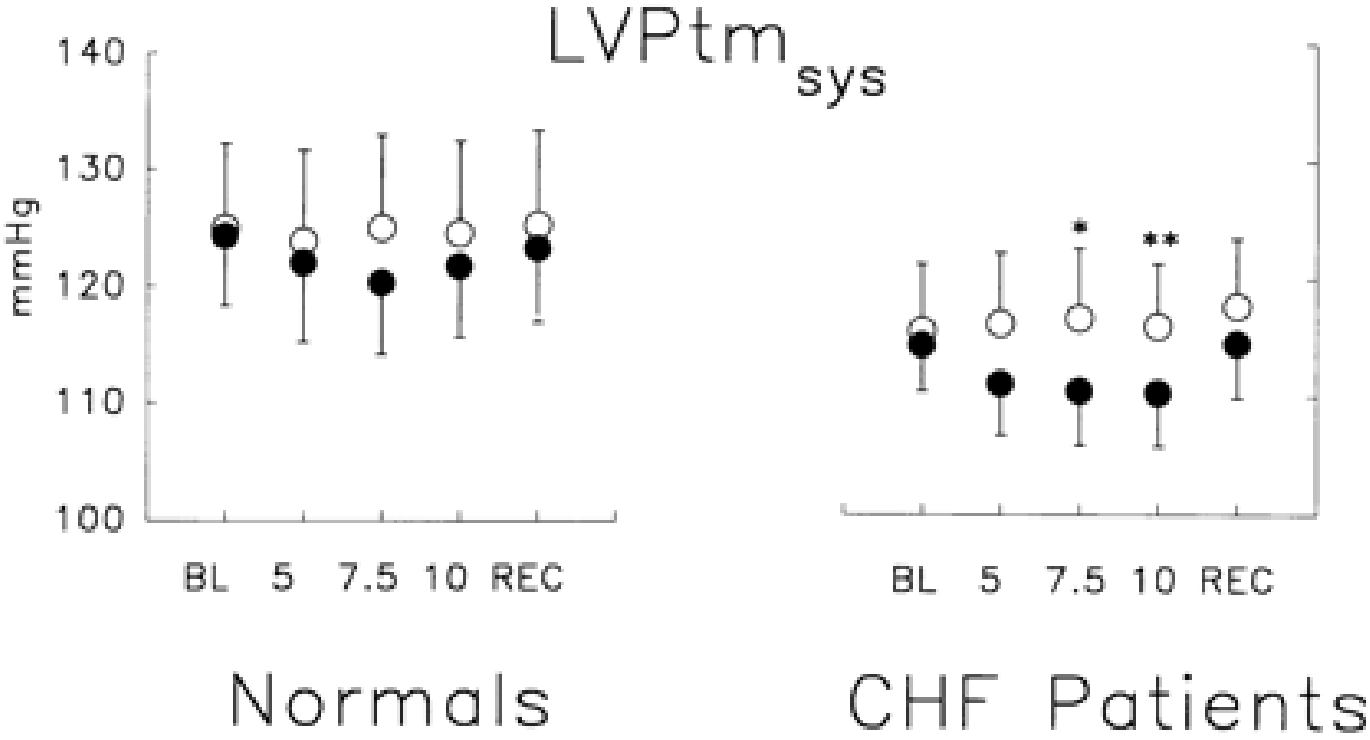


Naughton, *Circulation 1995*

Effets de la CPAP sur l'OAP :
- Diminution de la post charge du VG
- Seulement chez l'insuffisant cardiaque
- À partir de 7,5 cm H_2O

● période **CPAP**

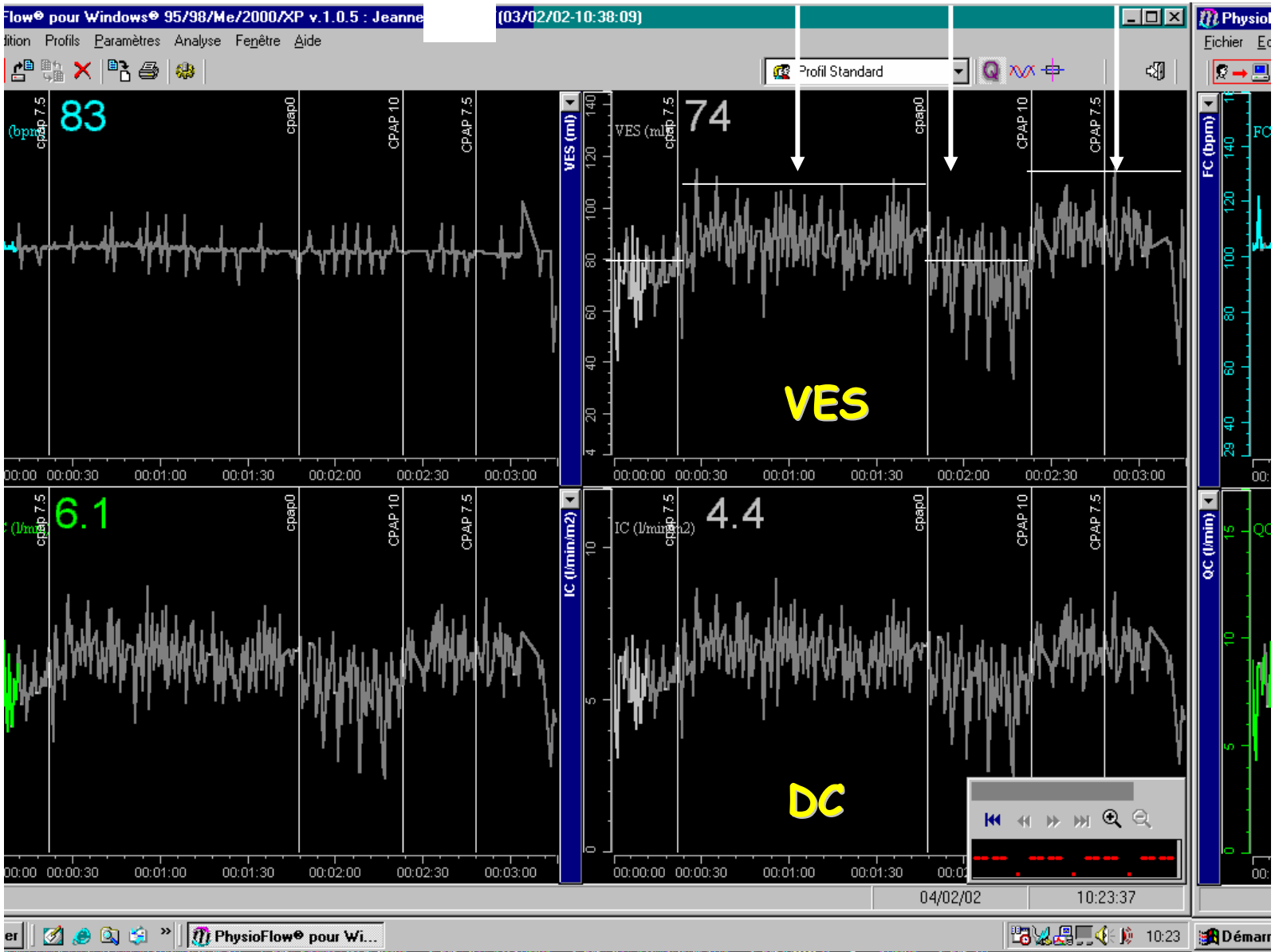
O période **contrôle** (O_2 nasal)



Naughton, *Circulation 1995*

CPAP et fonction cardiaque / impédancemétrie

PEP 7,5 PEP 0 PEP 10



Exemple :

Avant CPAP

Après 30 min de CPAP

Devenir des patients
Les études cliniques

Noninvasive ventilation in acute cardiogenic pulmonary edema: systematic review and meta-analysis. *Masip J, JAMA Dec. 2005.*

CPAP / O2

VS AI PEP / O2

CPAP / VS AI PEP / O2

CPAP / VS AI PEP

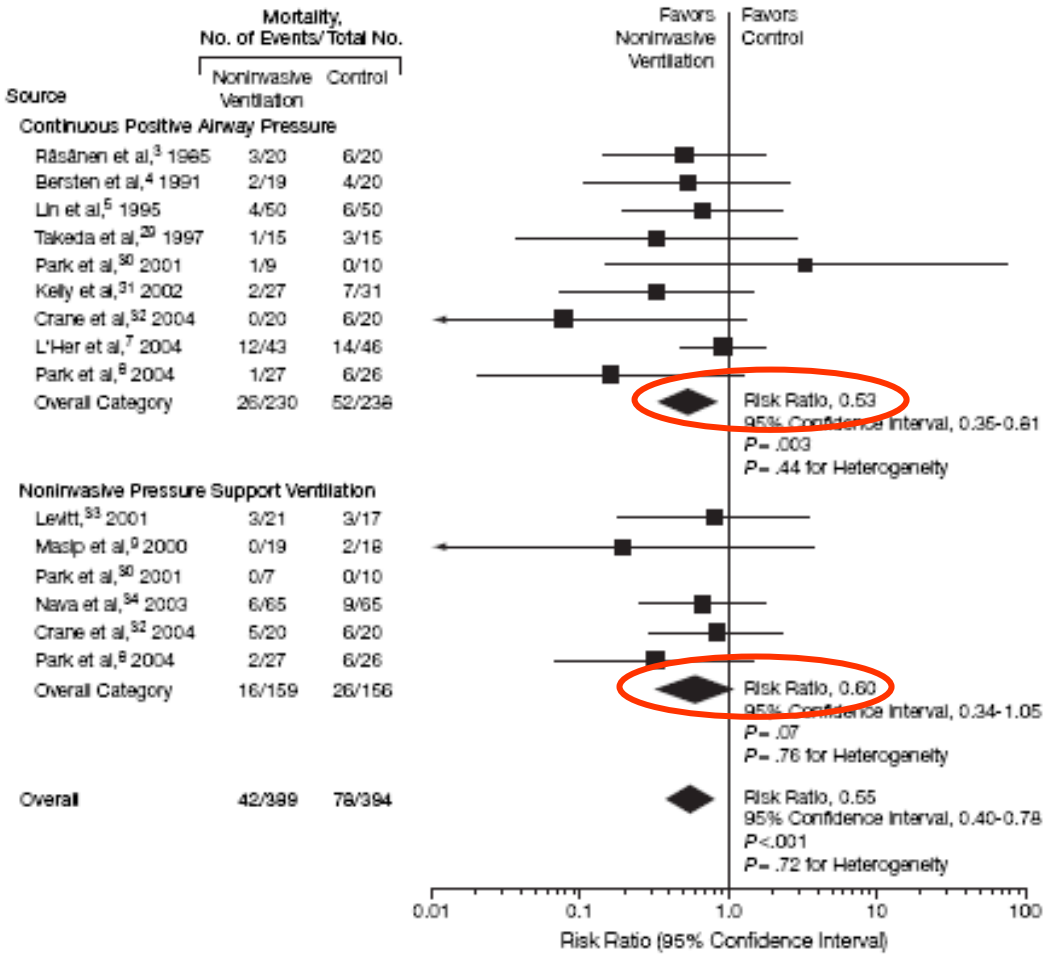
Table. Randomized Studies Analyzing Noninvasive Ventilation

Source	Location	Sample Size*	Mask	CPAP, cm H_2O	IPAP/EPAP, cm H_2O	Primary Outcomes	Other Considerations
Continuous Positive Airway Pressure vs Oxygen Therapy							
Räsänen et al,[3] 1985	1 ICU in Finland	40	Full face	10		Clinical outcomes	
Bersten et al,[4] 1991	1 ICU in Australia	40 (39)	Full face	10		Intubation	
Lin et al,[5] 1995	1 ICU in Taiwan	100	Full face	2.5-12.5		Intubation In-hospital mortality	Swan-Ganz catheterization
Takeda et al,[29] 1997	1 ICU in Japan	30 (29)	Full face or nasal	4-10		Laboratory parameters	Measurement of plasma endothelin 1
Kelly et al,[31] 2002	1 ED and ICU in the United Kingdom	58	Full face	7.5		Clinical outcomes Laboratory parameters	Measurement of plasma neurohormonal concentrations
L'Her et al,[7] 2004	4 EDs in France	89	Full face	7.5		48-h mortality	Elderly patients (>75 y)
Noninvasive Pressure Support Ventilation vs Conventional Oxygen Therapy							
Masip et al,[9] 2000	1 ICU in Spain	40 (37)	Full face		20/5, Mean	Intubation Resolution time	IPAP was adjusted to tidal volume
Levitt,[33] 2001	1 ED in the United States	38	Full face or nasal		8/3 Initial	Intubation	Prematurely interrupted when the study by Mehta et al[35] was published
Nava et al,[34] 2003	5 EDs in Italy	130	Full face		14.5/6.1, Mean	Intubation	Post hoc analysis in hypercapnic patients
Trials With 3 Study Groups							
Park et al,[30] 2001	1 ED in Brazil	26	Full face and nasal	5-12.5	8/3 Initial	Intubation	Full-face mask for CPAP and nasal for NIPSV
Crane et al,[32] 2004	2 EDs in the United Kingdom	60	Full face	10	15/5 Fixed	Success in ED (2 h) In-hospital mortality	Prehospital nitrates therapy evaluated
Park et al,[8] 2004	1 ED in Brazil	83 (80)	Full face	10 Initial up to 10	15/10 Initial	Intubation	
Continuous Positive Airway Pressure vs Noninvasive Pressure Support Ventilation							
Mehta et al,[35] 1997	1 ED in the United States	27	Nasal and full face	10	15/5 Fixed	Intubation Physiological improvement	Prematurely stopped for higher rate of AMI in NIPSV group
Bellone et al,[36] 2004	1 ED in Italy	36	Full face	10	15/5 Initial	AMI	Study restricted to patients with hypercapnia
Bellone et al,[37] 2005	1 ED in Italy	46	Full face	10	15/5 Initial	Resolution time	Primary end point was AMI rate Only nonischemic APE

Noninvasive ventilation in acute cardiogenic pulmonary edema: systematic review and meta-analysis. *Masip J, JAMA Dec. 2005.*

Mortalité

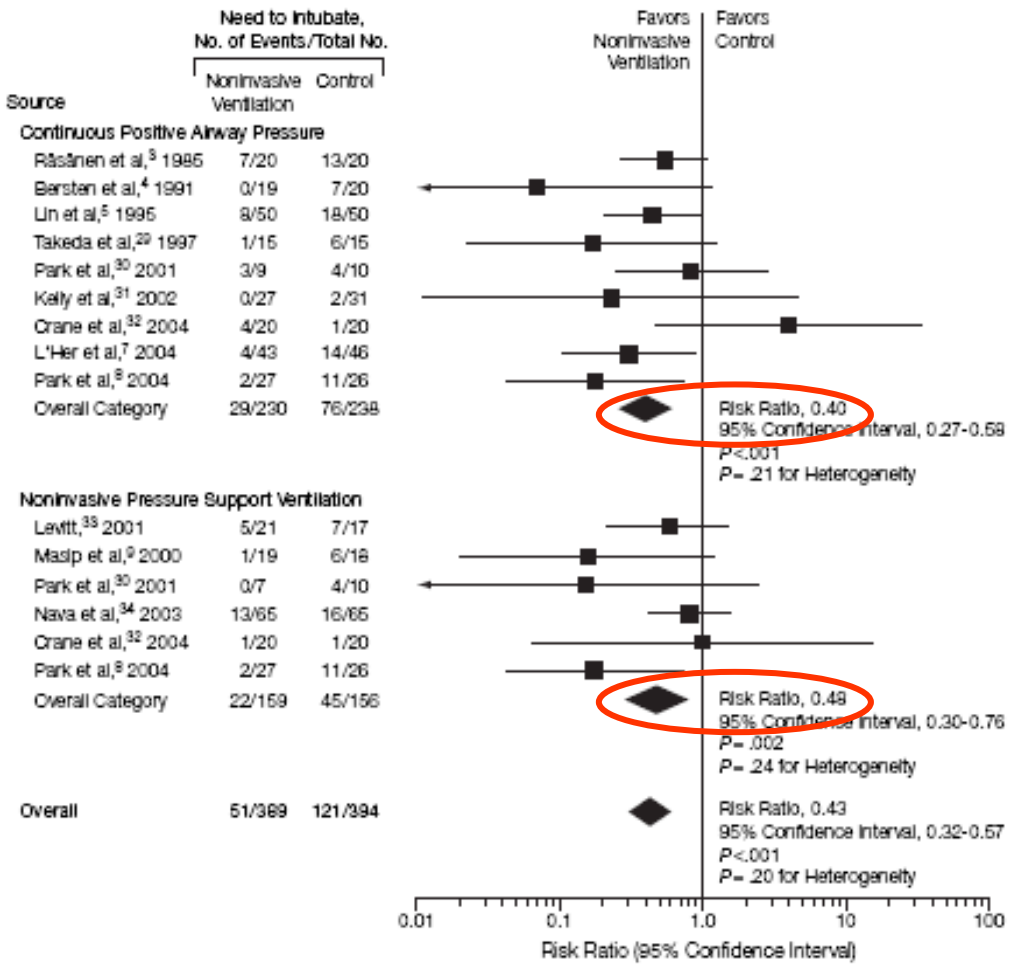
Figure 2. Effects of Noninvasive Ventilation on Death



Data markers are proportional to the amount of data contributed by each trial.

Atteinte des critères d'intubation

Figure 3. Effects of Noninvasive Ventilation on Need to Intubate



ESC Guidelines: Management of AHF

Niemenen et al. Eur. Heart J. 2005, 26 : 384-416

9.2.3. *Conclusions*. The use of CPAP and NIPPV in acute cardiogenic pulmonary oedema is associated with a significant reduction in the need for tracheal intubation and mechanical ventilation.

Class IIa recommendation, level of evidence A

There are insufficient data to demonstrate a significant reduction in mortality; however, the data do not trend in that direction.

ESC Guidelines: Management of AHF

Niemenen et al. Eur. Heart J. 2005, 26 : 384-416

10.3.1. Nitrates. Nitrates relieve pulmonary congestion without compromising stroke volume or increasing myocardial oxygen demand in acute left heart failure, particularly in patients with acute coronary syndrome. At low doses they only induce venodilation, but as the dose is gradually increased they cause the arteries, including the coronary arteries, to dilate. With appropriate doses, nitrates exert balanced vasodilation of the venous and arterial sides of the circulation, thereby reducing LV pre-load and after-load, without impairing tissue perfusion. Their effect on cardiac output depends on pre-treatment pre-load and after-load and the ability of the heart to respond to baroreceptor-induced increases in sympathetic tone.

Initially nitrates may be given orally but intravenous nitrates are also well tolerated in AMI. Two randomized trials in AHF have established the efficacy of intravenous nitrates in combination with furosemide and have demonstrated that titration to the highest haemodynamically tolerable dose of nitrates with low dose furosemide is superior to high dose diuretic treatment alone.

Class I recommendation, level of evidence B

10.5. Diuretics

10.5.1. Indications. Administration of diuretics is indicated in patients with acute and acutely decompensated heart failure in the presence of symptoms secondary to fluid retention.

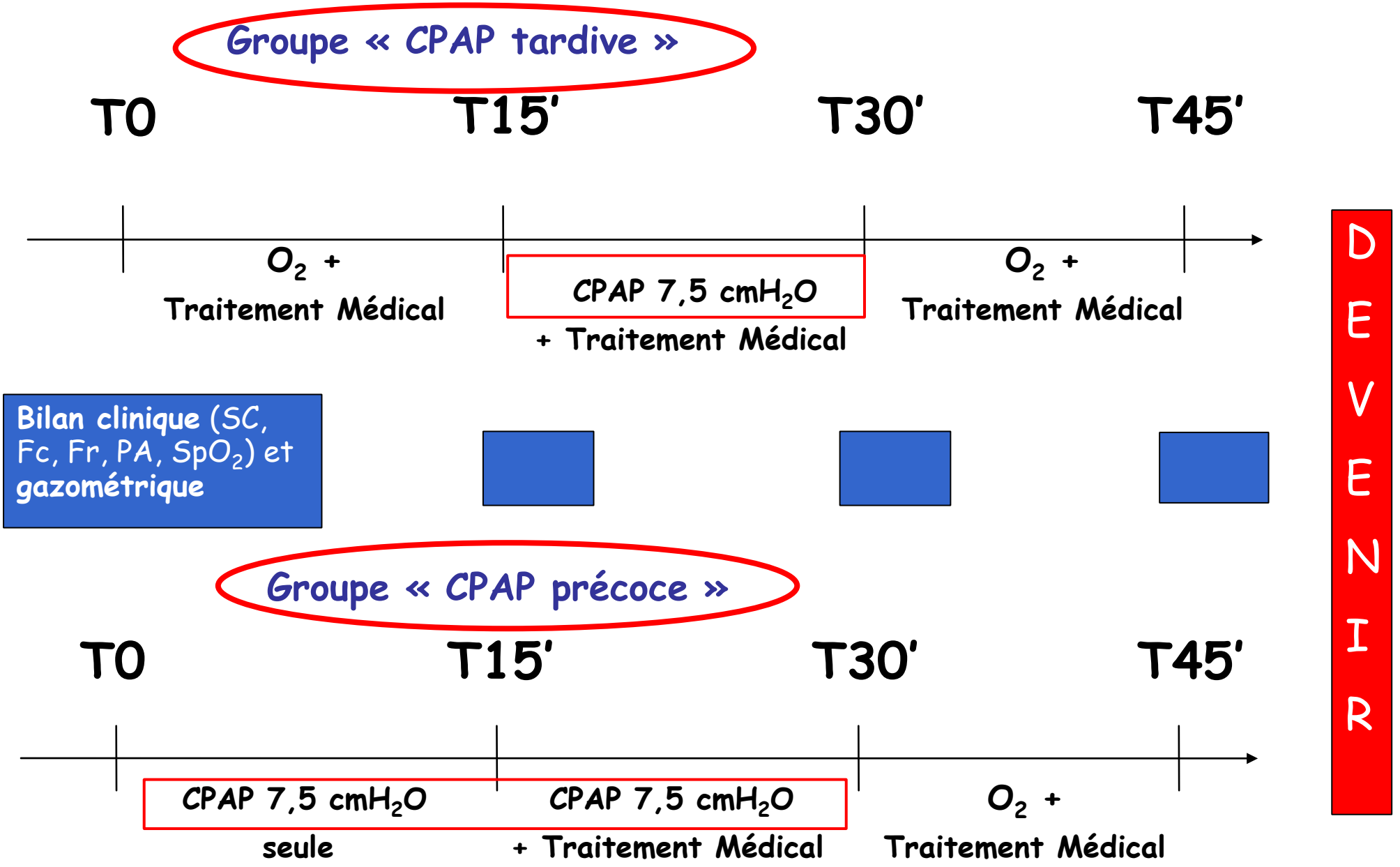
Class I recommendation, level of evidence B

Intérêts multiples de la CPAP :

- Possède à elle seule les effets de tous les médicaments de l'OAP
- Sans les effets secondaires (hypovolémie, I+, …)
- Effets réversibles
- CPAP seule en pré-hospitalier ?

Benefit of immediate CPAP in out-of-hospital management of CPE.

P. Plaisance. *Eur Heart J. submitted*

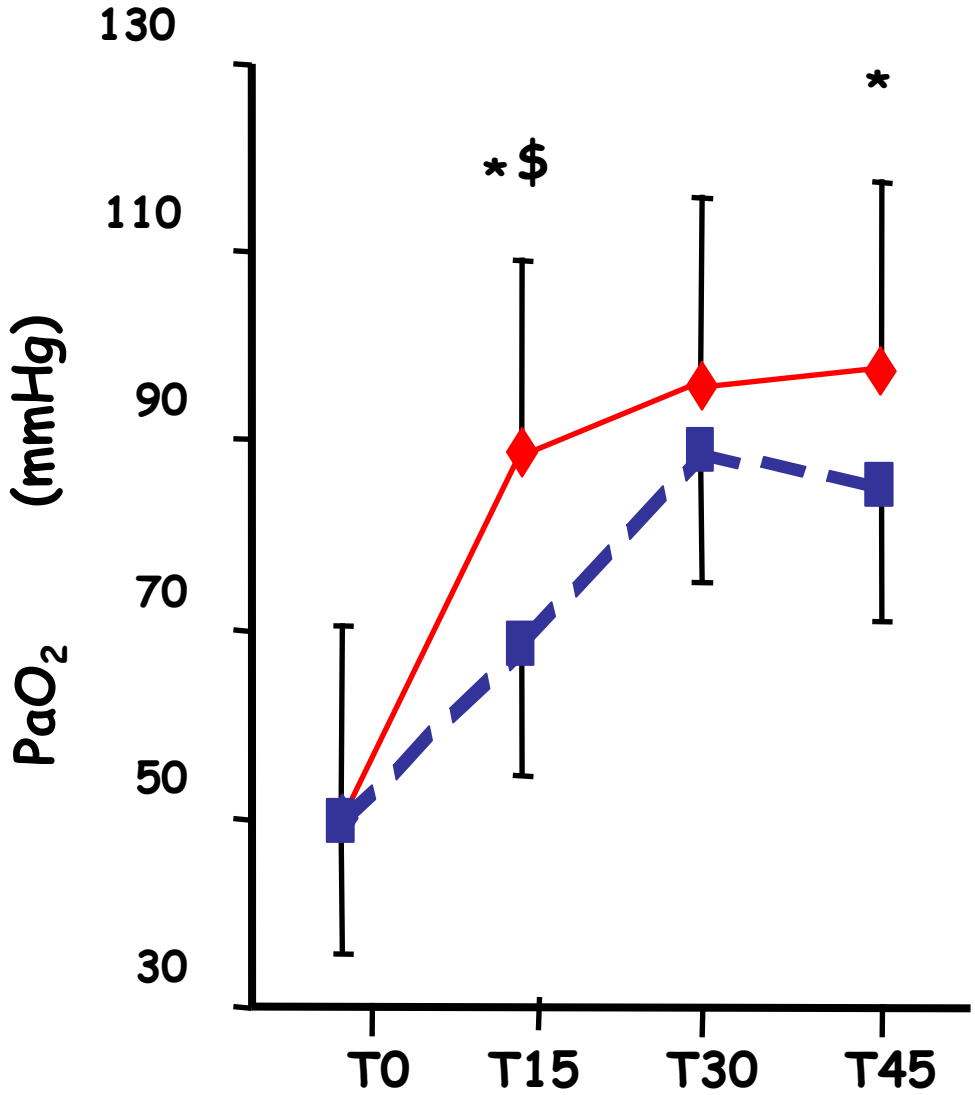


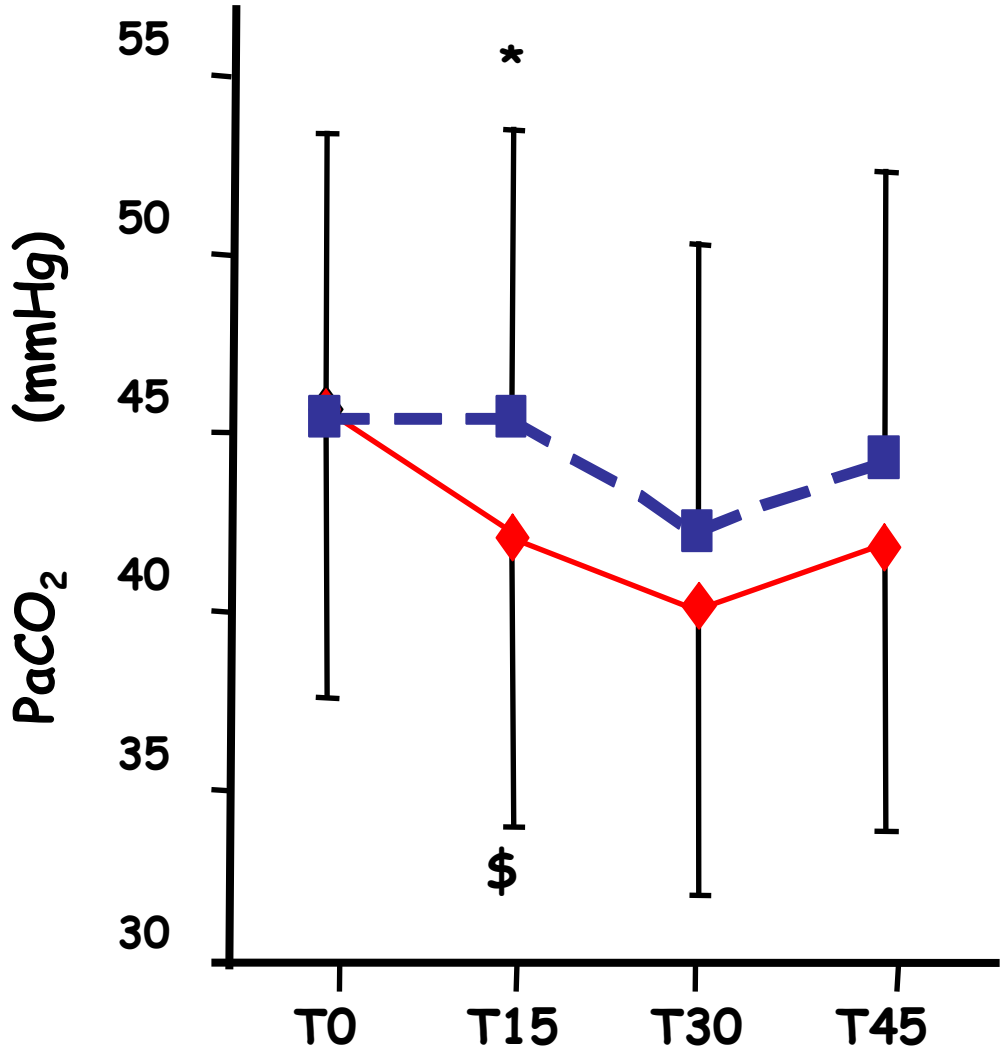
Évolution gazométrique

CPAP précoce ___ CPAP tardive - - -

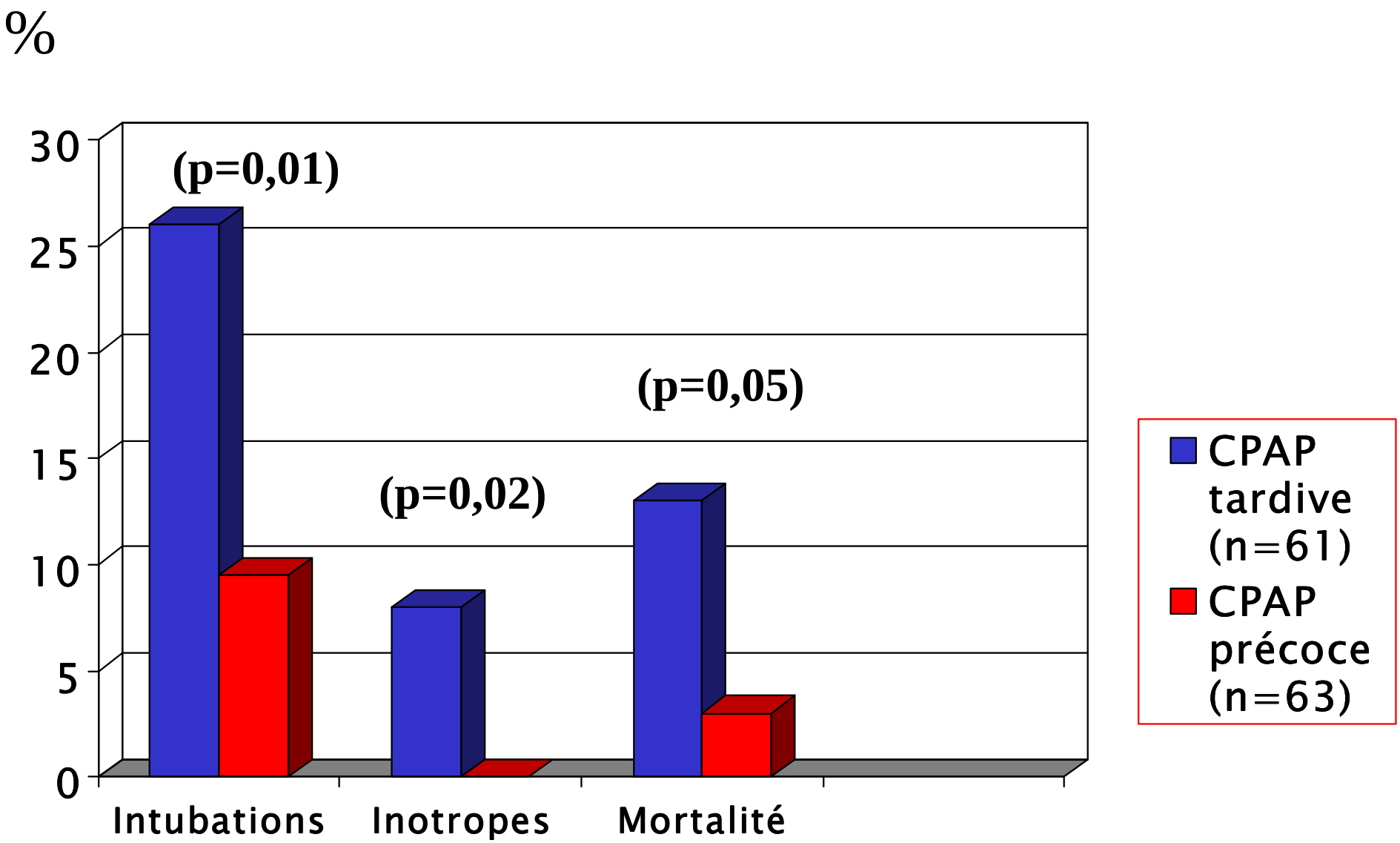
* p<0,05 CPAP précoce *vs* tardive

$ p<0,05 CPAP précoce : T15 *vs* T0





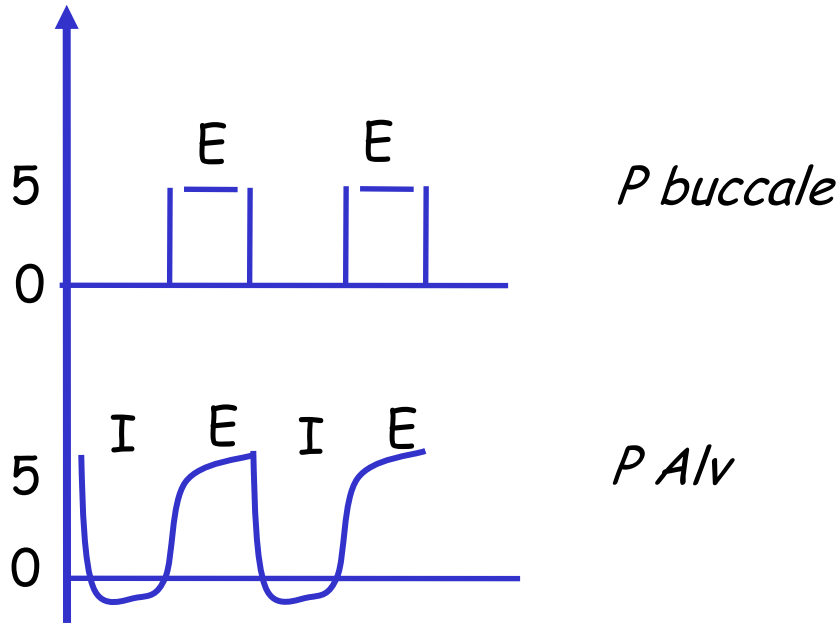
Devenir des patients



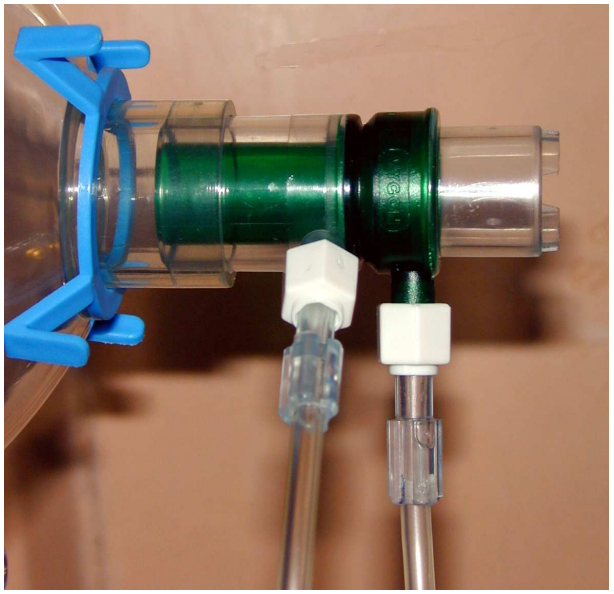
La CPAP en pratique

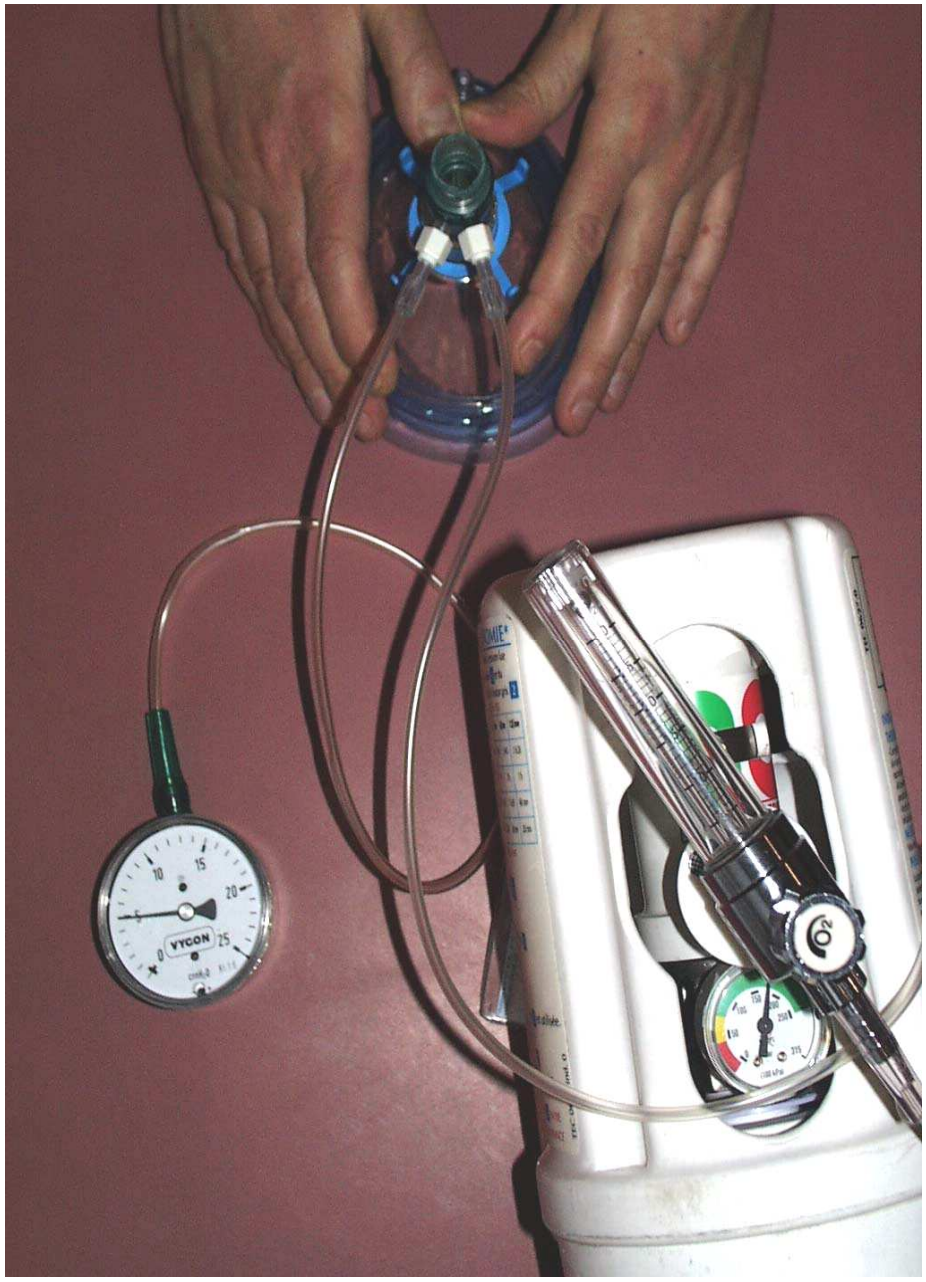
- Protocole de mise en place et de surveillance (formation ++)
- Quelle interface ? :
  - masque naso buccal en 1ere intention (G2+)
  - “Total face masque”, “Helmet”, ... ?
- Quelle pression ? :
  - PEP : 7,5 à 10 cm H_2O
- Quelle CPAP ?

Ballon réservoir : « ancienne » VS-PEP



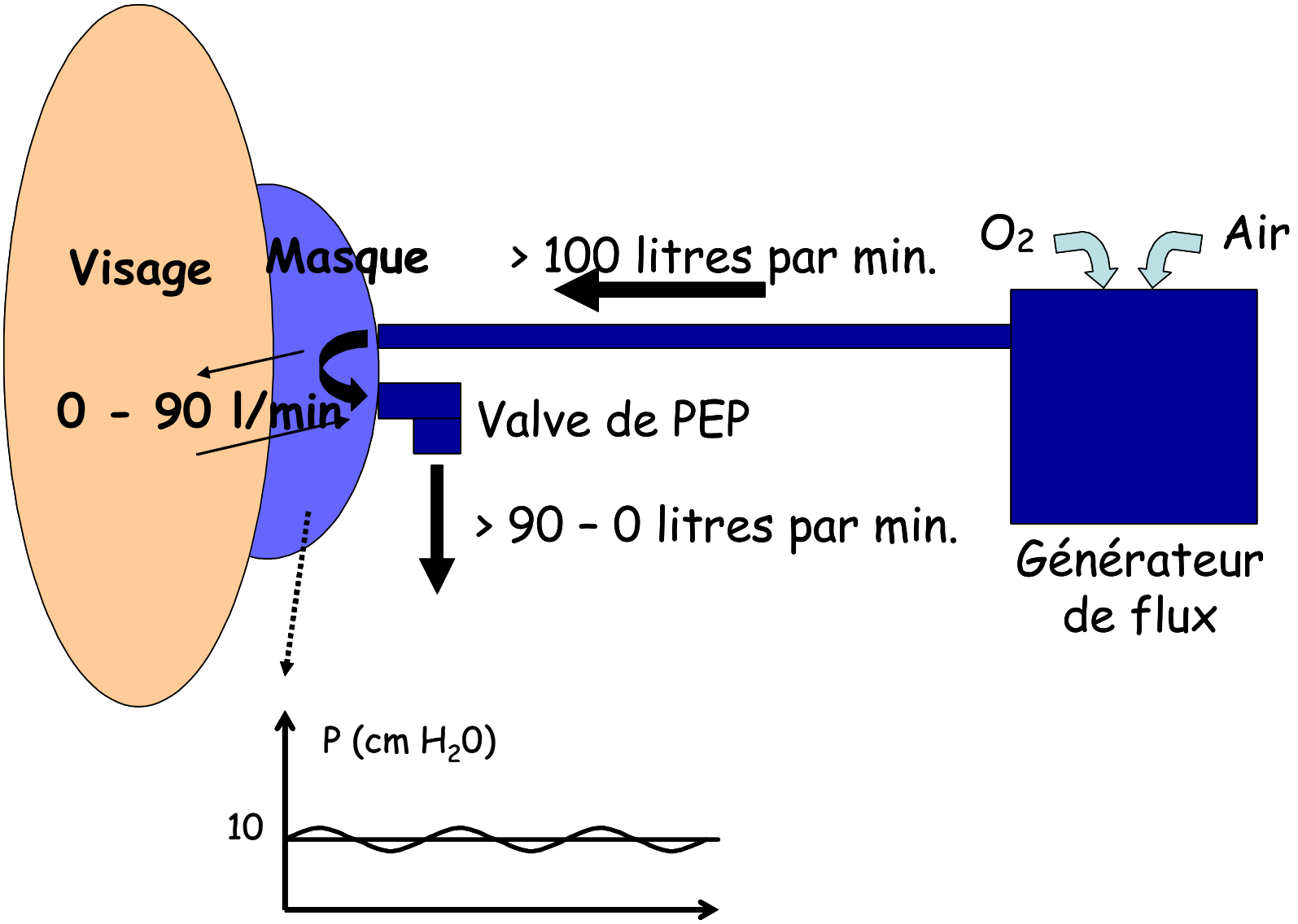
CPAP « Boussignac »



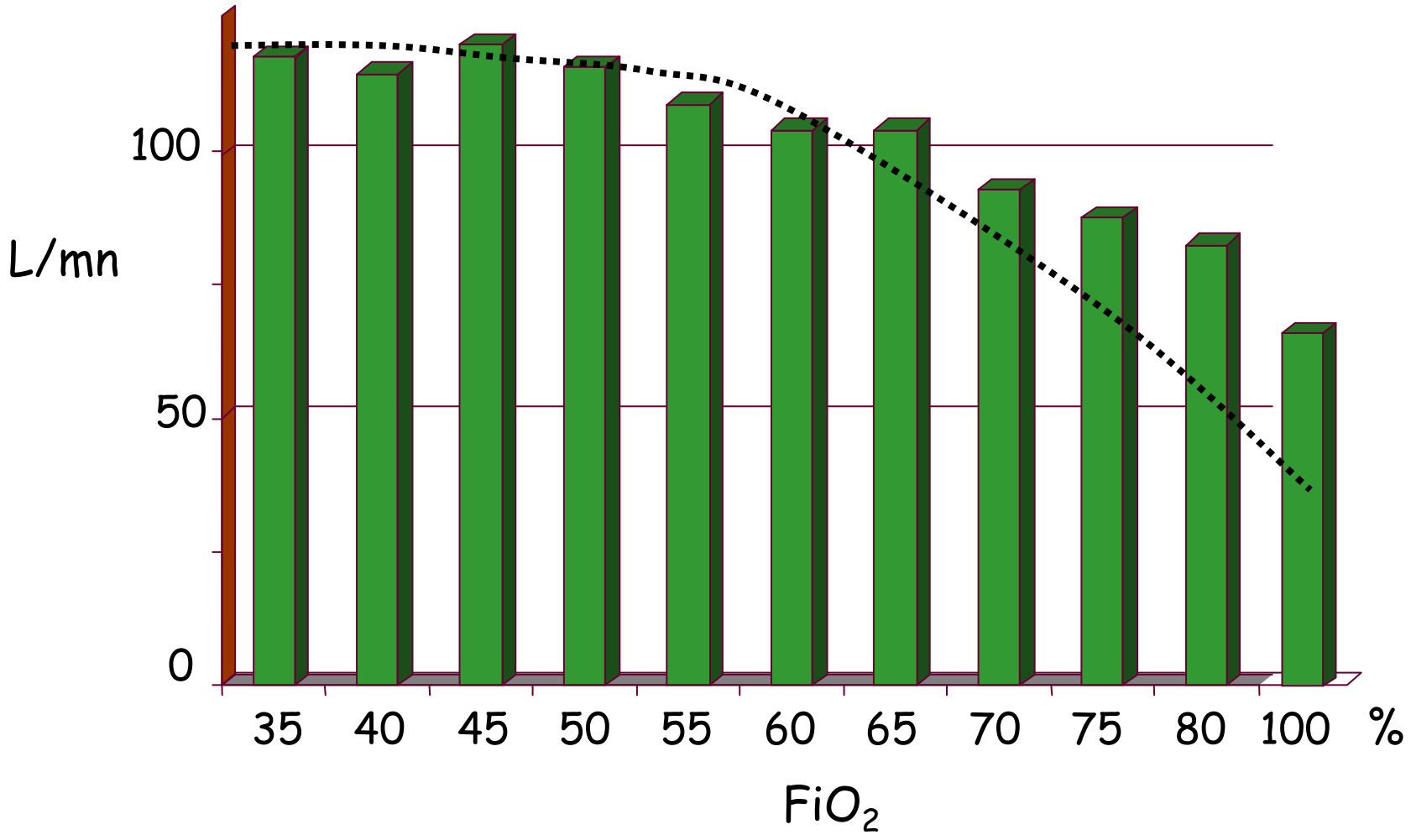


CPAP « Venturi »

Conditions pour une "vraie CPAP"



Relation Débit de gaz/FiO_2

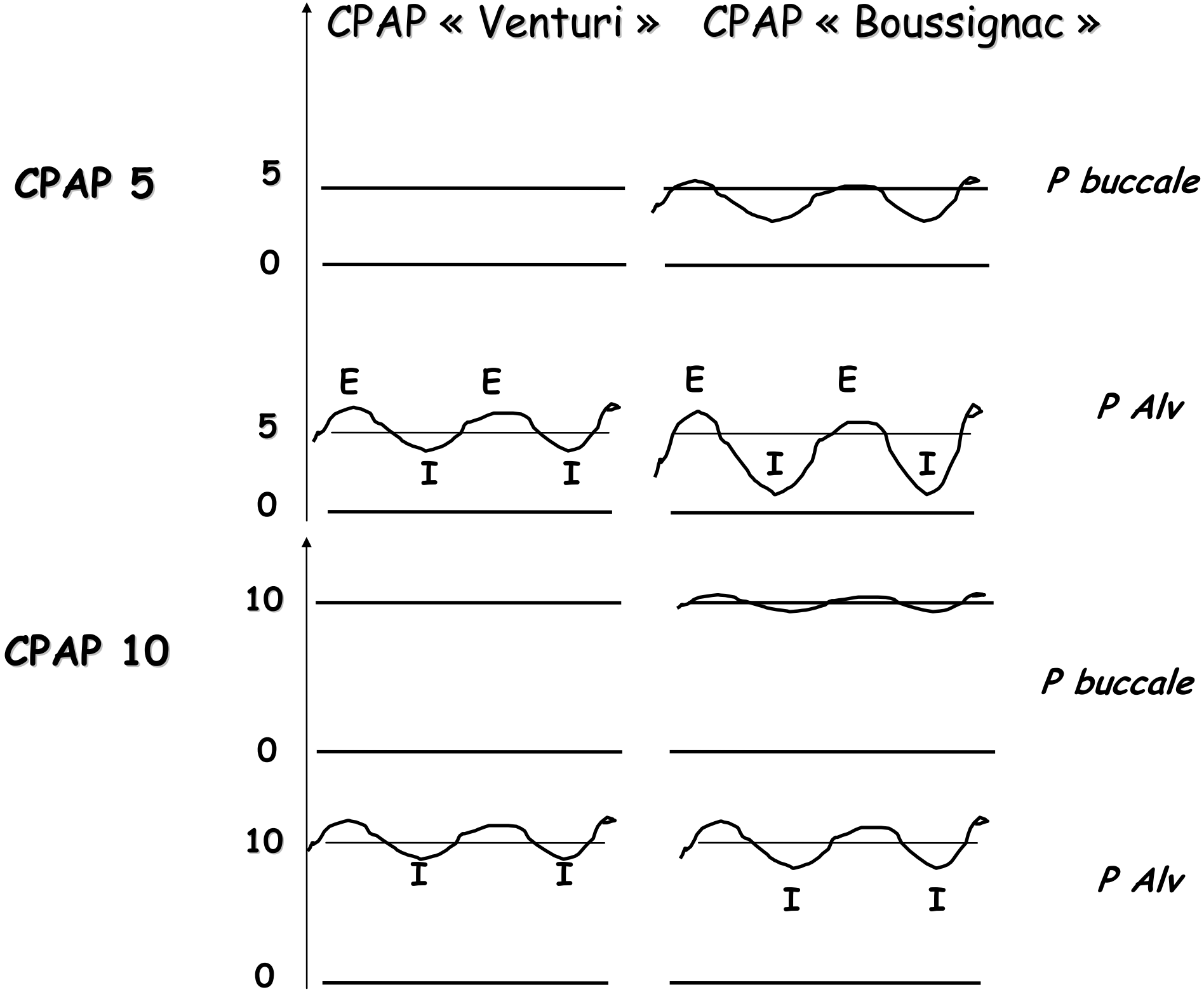


Débit CPAP conservé jusqu'à FiO_2 60%

FiO_2 minimale

Débit Maximal

= Flux total maximal


CPAP « Venturi »
CPAP « Boussignac »
CPAP 5
5
0
P buccale
E
E
I
I
5
0
P Alv
CPAP 10
10
0
P buccale
10
0
P Alv

Conference de consensus
VNI 2006

“La CPAP par effet venturi est la plus adaptée en pré-hospitalier”

Contre-indications de la VNI dans l'OAP

- Coma, …
  - sauf si hypercapnie sur IRA / BPCO.
  - →Idem dans l'OAP
- Intubation imminente, …
  - sauf en pré-oxygénation
- Vomissements
- Etats de choc, collapsus, troubles du rythme graves ++
- Agitation, non coopération, …
  - Sauf si hypercapnique

Effets indésirables

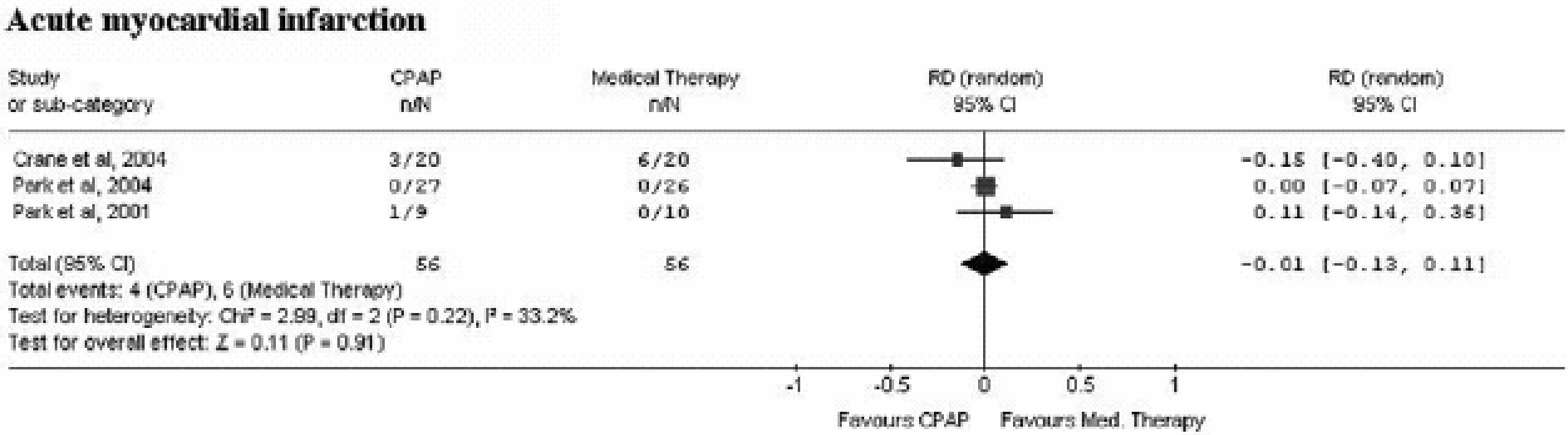
- Hypotension artérielle (diminution du retour veineux)
- Baro-traumatisme
- Distension gastrique, nausées, vomissements
- Lésions cutanées
- Infarctus ?

Efficacy and safety of non-invasive ventilation in the treatment of acute cardiogenic pulmonary edema – a systematic review and meta-analysis

João C Winck[1], Luis F Azevedo[2,3], Altamiro Costa-Pereira[2,3], Massimo Antonelli[4] and Jeremy C Wyatt[5]

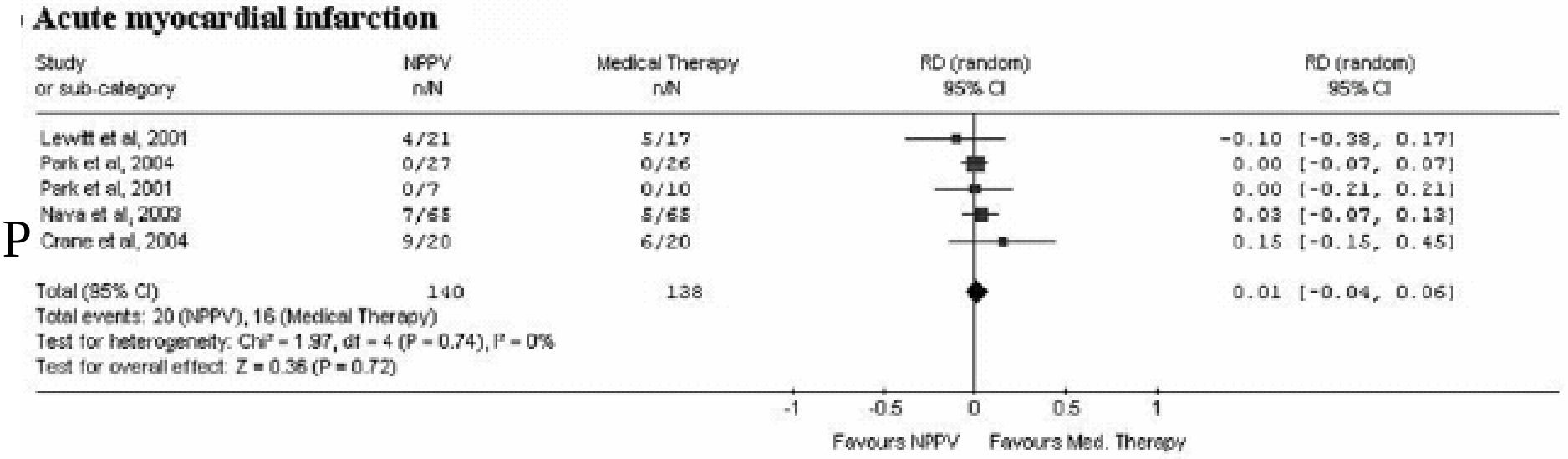
Critical Care Vol 10 No 2 Winck et al.

CPAP



VS

AI PEP



VS-PEP ou VS-AI-PEP ?
(CPAP ou VNI ?)

LIPPINCOTT WILLIAMS & WILKINS

Critical Care Medicine

OFFICIAL JOURNAL OF THE SOCIETY OF CRITICAL CARE MEDICINE

Cardiac and respiratory effects of continuous positive airway pressure and noninvasive ventilation in acute cardiac pulmonary edema

Chadda, K, et al, Volume 30(11) , November 2002, pp 2457-2461

Table 2. Respiratory and mechanics variables during spontaneous breathing (SB), 5 and 10 cm H_2O continuous positive airway pressure (CPAP5 and CPAP10), noninvasive positive pressure ventilation (NPPV), and return to spontaneous breathing (RSB)

Ventilatory Mode	SB	CPAP5	CPAP10	NPPV	RSB	*p*
V_T, mL	518 ± 44	597 ± 70	562 ± 48	656 ± 123[a]	530 ± 65	.018
RR, breaths/min	20 ± 2	19 ± 2	19 ± 3	18 ± 2	20 ± 2	.725
V_E, L/min	10.5 ± 1.2	11.3 ± 1.7	10.7 ± 1.9	13.1 ± 1.8	10.1 ± 1.3	.340
V_T/T_I	0.47 ± 0.05	0.50 ± 0.07	0.48 ± 0.05	0.54 ± 0.13	0.48 ± 0.05	.225
T_I/T_{TOT}	0.39 ± 0.02	0.41 ± 0.03	0.36 ± 0.02	0.36 ± 0.02	0.38 ± 0.03	.234
CL_{dyn}, L/cm H_2O	0.119 ± 0.049	0.127 ± 0.065	0.152 ± 0.073	0.153 ± 0.047	0.118 ± 0.047	.475
ΔPes, cm H_2O	10.56 ± 2.43	8.56 ± 1.83	8.75 ± 2.57	6.58 ± 2.60[a]	10.86 ± 2.87	.020
PTPes, cm H_2O·sec/min	212 ± 65	172 ± 77	191 ± 55	146 ± 76[a]	203 ± 68	.001

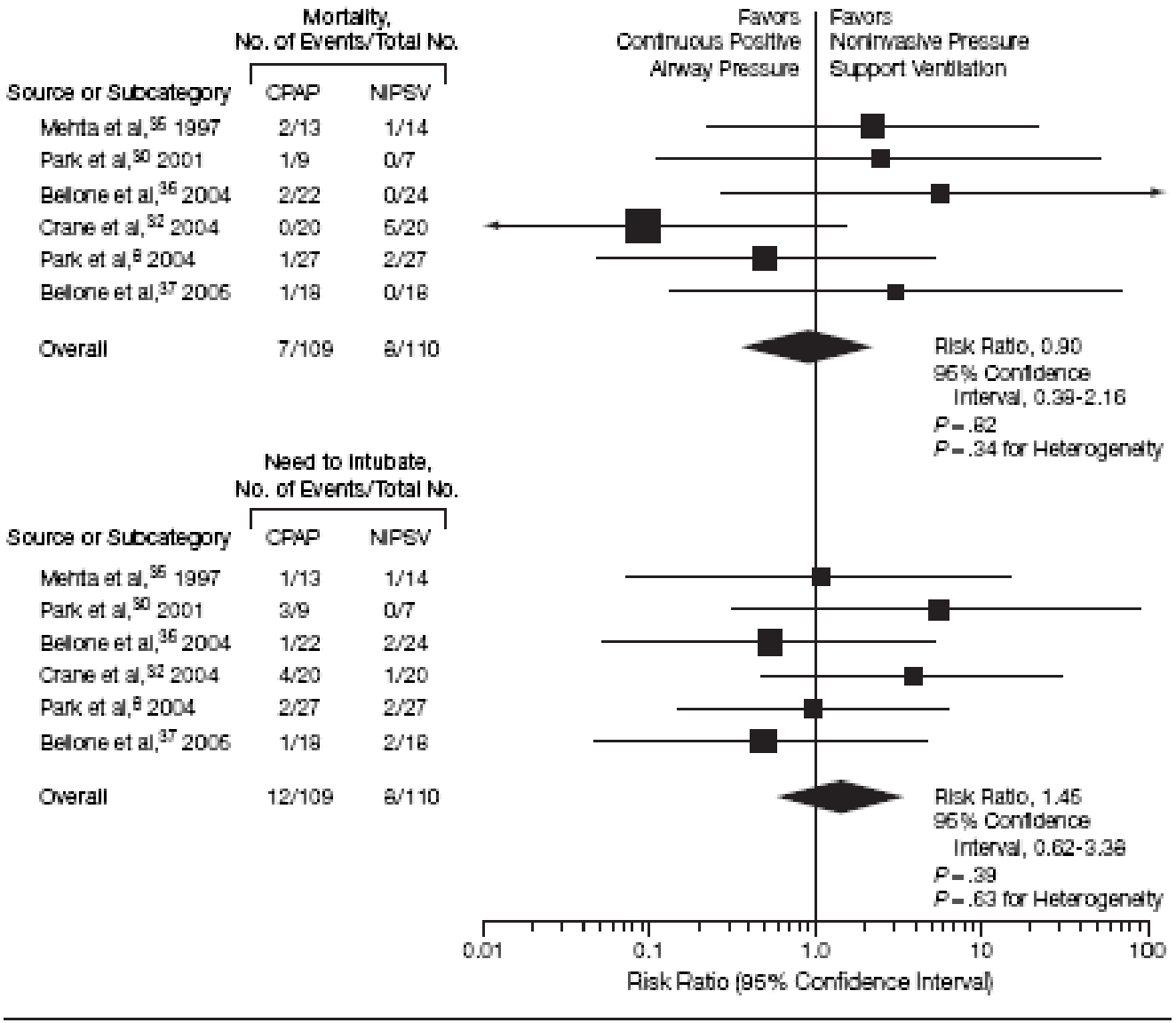
V_T, tidal volume; RR, respiratory rate; V_E, minute ventilation; V_T/T_I, mean inspiratory flow; T_I/T_{TOT}, inspiratory duty cycle; CL_{dyn}, dynamic pulmonary compliance; ΔPes, esophageal pressure; PTPes, esophageal pressure-time product.

[a] $p < .05$, Bonferoni test vs. SB and RSB.

Conclusion : NPPV causes a greater reduction in respiratory load compared to CPAP but with similar improvement in cardiac output

Noninvasive ventilation in acute cardiogenic pulmonary edema: systematic review and meta-analysis. *Masip J, JAMA Dec. 2005.*

Figure 4. Effects of Continuous Positive Airway Pressure vs Noninvasive Pressure Support Ventilation



Ventilation Non Invasive

Conférence de consensus commune SFAR, SPLF, SRLF.

Oct. 2006

- En pré-hospitalier ou aux urgences :
  - La VNI se limite à la VS-PEP sur l'OAP (G1+)
  - VS-AI-PEP ?
    - pour OAP ou BPCO
    - uniquement si équipe entraînée et équipée de respirateurs adaptés (G2+)

Autres indications de la CPAP en pré hospitalier

- BPCO → non
- Asthme → non
- Dyspnée obstructive haute → non (trachéomalacie oui. G2+)
- Contusion pulmonaire ?
  - Recommandations : il faut probablement faire (G2+. VS-PEP ou VS-AI-PEP)
  - Sauf si pneumothorax
  - → pas en pré-hospitalier
- Autres indications ? …

Cas clinique

- Intervention SMUR pour dyspnée chez un patient de 55 ans avec un cancer pulmonaire évoluant depuis 1 an
- A l'arrivée coma, sueurs, cyanose, tirage, SpO2 60%, encombrement ++
- Intubation ?
- Abstention ?
- La CPAP permet de restaurer une PaO2, puis de réaliser une aspiration trachéale sans risque et laisse du temps pour la discussion
- Donc : hypoxémie sévère sur trouble de ventilation, en préparant l'intubation ou en attente de décision (cancer, maladie incurable neuro musculaire, fin de vie pour confort ... = G2+)

Conclusions

- **CPAP et OAP** ++ : indication principale de la VNI au SMUR et aux urgences
- Possiblement seule en début de traitement, **effet** “**starter**”
- Si patient **hypercapnique,** mais aussi dès que défaillance respiratoire
- Pression **7,5 – 10** cmH2O
- Pression **constante** à contrôler ++
- **Débit maximal** : FiO2 mini
- Pas de risque pour le patient
- **VS-AI-PEP** : éventuellement, si équipe **formée**, pour **BPCO**